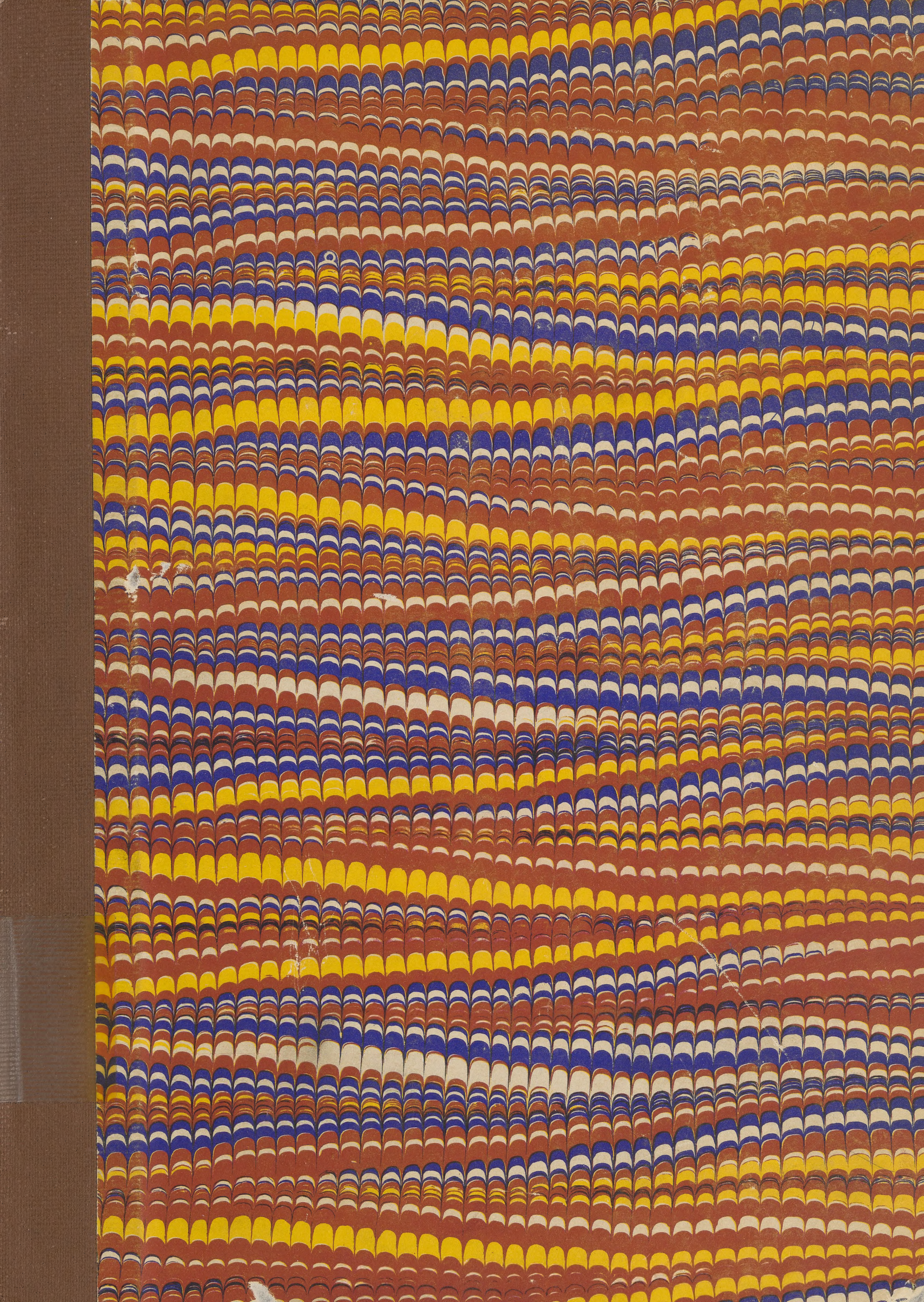
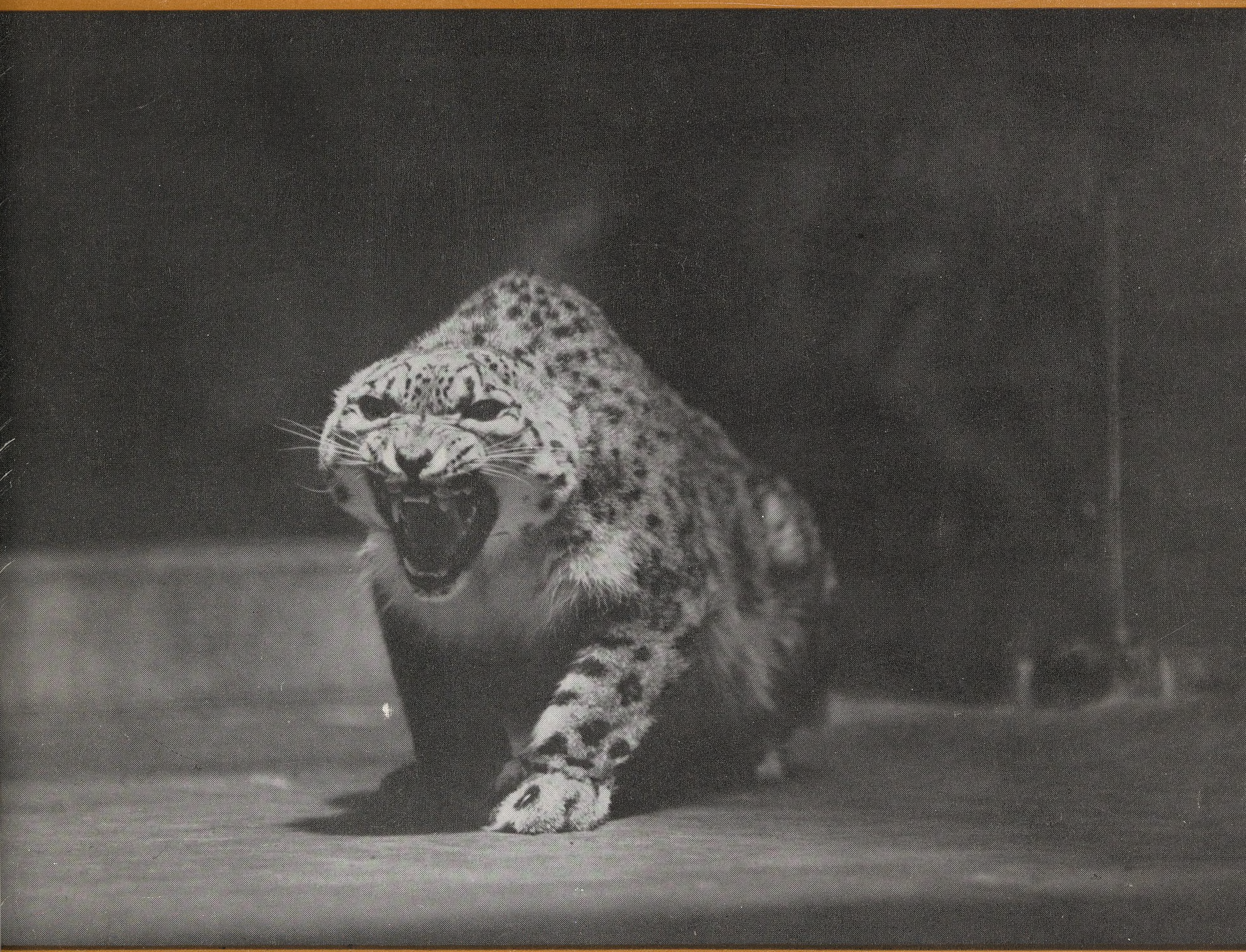






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The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

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Annual Membership in the Society is \$10, renewable annually. Life Membership may be obtained for \$200. A contributor of \$1,000 becomes a Patron; \$2,500 an Associate Founder; \$5,000 a Founder; \$10,000 a Founder in Perpetuity, and \$25,000 a Benefactor.

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The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



The pronghorn puts his trust in speed—and his best speed is said to approach sixty miles an hour. This picture was taken from an airplane by Charles J. Belden and shows part of his own herd of 4,000 antelope on the range at Pitchfork, Wyoming.

BULLETIN

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Out in the Pronghorn Country

A National Antelope Refuge Is Proposed for "the Most American of American Big Game Animals"

ALBERT C. ANTREI

Fort Collins, Colorado

WHERE long, empty, silent spaces roll from one horizon to the next, there the pronghorn antelope gallops and races and flashes his white rump-flag in the sun like a heliograph signal. That is the country where the coyote's howl is well known, where the "johnrabbits" and cottontails dodge, the rattlesnake coils, the prairie dog burrows, and the sullen badger digs and growls.

Only single or scattered groups of spreading trees jealously guarding waterholes and springs break the monotony of the tallgrass, the shortgrass, the green grass, the burned and dried grass, and the big patches of cactus where there is hardly any grass at all. The wind and the sun burn the human skin deeply, the rain (when it comes) drives clear to the bone and hail pelts with bruising force.

Antelope country is country that the Plains tribes loved and fought to hold in the days when the grass was greener and fences were farther apart. There never was a man more happily close to nature than the aboriginal American, and his mythology and songs are richly filled with the thunder, the wind, the buffalo, the antelope and all the other beasts and elements he strove against and lived with. Many a Kiowa tom-tom has beat time to the Song of the Antelope Ceremony while Kiowa voices chanted the words. If you know an old Kiowa (or Gaigwu, as they called themselves), ask him to sing you the ancient verse known as T'Apk'o Daagya, the Song of the Antelope

Ceremony. He must be a very old Kiowa, for many things have changed and it has been many, many summers since the Gaigwu performed the ceremony. It has practically gone now, in favor of the white man's teachings, along with many other tribal glories.

*Ton-k'an giapowitzep no
Tainkyowitte tam hol
Komdombe tonok'o
T'sainiya ode domgya*

*My grandmother punished me;
I wept until I fell asleep.
In dream came a holy power, wonderful
And mighty, to win food.*

The Gaigwu tell a legend of a little boy who was punished by his grandmother for losing a spoon. Sobbing, the boy lay down on a couch in the tipi and cried himself to sleep. He dreamed a wonderful dream in which a Mysterious Power visited him and bestowed upon him the might to kill game when he wished.

At length a great famine came upon the Gaigwu and they became very hungry. The antelope had disappeared from the prairie and even the buffalo were gone. Little Boy told his grandmother to summon the people to their tipi, but the old woman refused, for she feared being laughed at. But Little Boy himself called them and as many as could crowded into his lodge. Little Boy sat opposite the door and made two arrows, one from the wild cherry¹ and the other from the wood of the plum-tree².

¹ Symbol of spring fruitfulness.

² Symbol of autumn fruitfulness.

Then he stood the arrows in the ground before him and began to sing T'Apk'o Daagya, the Song of the Antelope Ceremony. He sang it several times and often took the arrows from the ground and waved them in time to his song. After each verse he shook them and blew on a whistle made from eagle-bone. Each time he blew, lo! antelope fur descended in showers from the arrows.

Then his singing was done, and as the Gaigwu marveled at his greatness he reached with his bow down to the couch where he had cried himself to sleep many, many moons ago in the time of plenty, and as he drew back his bow, lo! it caught an antelope by the horns, and Little Boy dragged him forth to show him to all that they might know how great his medicine was. And all that night the Gaigwu sang together the mystic antelope ceremony.

The next morning all the hunters went out on the prairie, and through Little Boy's mystic powers they killed many antelope where before there had been none to kill, and the Gaigwu ate and were happy again.

Thus, the pronghorn antelope entered the legends of the Kiowa.

FROM a very deep interest in aboriginal America there has grown in me a sincere appreciation of the pronghorn because among our native wild beasts it stands as the most typically American big game animal. The prongbuck (as our antelope is sometimes called) is only very distantly related to the antelopes and gazelles of Africa and Asia.

Not very many miles north of where this article is being written is the Colorado State Antelope Refuge, and no more typical pronghorn country exists anywhere. Its 69,000 acres lie in northeastern Larimer County and extend up to the Wyoming line. The antelope on the refuge number about five hundred, or one to every 138 acres. Water is scarce on the refuge, and good grass is none too plentiful. The wind blows almost incessantly and blizzards occasionally hit as late as May, and hit with terrific force. Dry-creek gulches, draws, buttes, cacti, sagebrush and yucca are numerous. The one main road which crosses the refuge from the southwest to northeast is nothing more than two parallel dirt tracks in which grass refuses to grow. There are many side roads that lead

to sheepherders' huts, dugouts and lambing sheds, and they all look exactly like the "main road." The word "trails" would more accurately describe the kind of roads on the refuge. It is no place for a stranger without a dependable guide, for it is a fairly simple thing to lose one's way and become what might seem hopelessly lost on the prairie, especially if one has a car to worry about and must therefore follow the trails.

It was on the refuge that I saw my first pronghorn antelope—at least, to recognize, for sometimes it is difficult to see a pronghorn unless you are looking for him.

A friend and I had gone into the refuge in the hope of acquainting ourselves more intimately with the pronghorn, and incidentally to find out for ourselves if they had any present day reaction to the flag-waving trick that old antelope hunters said would attract their curiosity.

The time was early April. All winter the sun had blessed northern Colorado with its warmth and the drought that had hit the West in the preceding summer had continued through the fall and winter.

But when my companion and I set foot on the antelope refuge in April the drought automatically ended! I don't claim credit for us for breaking the drought but, coincidentally or not, the drought *broke*, and all during the spring Colorado and her neighbors were deluged with snow, rain, and flood waters.

The wind blew with such particular chill violence that we feared a spring blizzard and sought shelter in a lambing camp that night. Anyone who is acquainted with western sheep camps will realize how much Mother Prairie had frightened us.

The next day broke cold and fairly clear, so we set forth to look for a pronghorn antelope. I say "a" pronghorn, because the foreman of the lambing camp had blandly informed us that antelope were "scarcer than hen's teeth" on the area, in the first place, and what-in-heck did we want with antelope, in the second place?

Sheepmen, it would seem, are not very observant. Less than a mile from the lambing camp we spotted a lone pronghorn trotting in the general direction of our camp, probably after water. As she came surprisingly close we could see that the animal was a pregnant doe.

She stopped twice to look us over carefully



The mature pronghorn is an animal of grace and dignity. This portrait shows how he gets his name.



(Left) Pronghorns were found on the Wichita National Game Preserve in 1907 when the New York Zoological Society presented a herd of bison to stock the preserve.



(Below) Many years ago the Zoological Park possessed herds of pronghorns and this is one of the animals photographed in 1903.



Photographs by Albert C. Antrei

(Top) A few trees jealously guard the waterholes and springs on the Colorado State Antelope Refuge. (Bottom) In such typical Colorado pronghorn country as this the antelope's keen sight constantly protects him against the approach of enemies.

and calmly. Excitement was totally absent in her, for she failed to raise the white flag on her hind quarters as a signal of danger to others of her kind. We stood very quietly to see what she would do. The wind was in our favor, but her eyes were in *her* favor, and as she made us out easily she lost all apparent interest and trotted off as gracefully and as unconcerned as before.

Somewhat disappointed that the meeting had been so brief, we continued toward a hill to the south from which we intended to scan the country.

I remember remarking that it appeared as if we might be in for a little climb through barbed-wire at the foot of the hill; we could not see the wire as yet, but we could faintly see what we thought were posts rather irregularly spaced. All in all, it was a mighty queer fence with a doubtful purpose, for seven posts were the only ones visible.

We were still discussing the sanity of the individual who had built such a fence when suddenly one of the "posts" turned sideways and changed into a lightshaded boulder. We were beginning to question our own sanity when all the "posts" turned sideways and began to trot! They were antelope, and they flashed their white with a vengeance.

In twenty or thirty minutes we had seen at least eight antelope close together where we had expected a hard and long search for single animals "as scarce as hen's teeth."

The patches of white did not run very far. In fact, they did not run at all—they simply galloped a little way. When we refused to move, the antelope stopped and lowered their heads to graze again. We resolved to see how close we could get to them. We made it a point to move slowly and to stop for a second every ten feet or so. When we were about two hundred yards from them, however, they all raised their heads and looked us over; upon finding us so close, their white danger signals raised and almost as one they again galloped away. A certain distance from us they stopped again to graze. We repeated the process four times. The fourth time they must have decided that they were tired of such shenanigans, and when they left the scene this time, they really opened up! Across the flat prairie they skimmed, making a picture that has never yet failed to thrill

me. The sight of a herd of those pretty, fleet-footed little animals covering a lot of territory in a few seconds flat is a sight that to me is worth almost any amount of Mother Prairie's ranting and raving.

We finally gained the top of our hill and looked back at the pronghorns. They were almost in the same spot where we had first disturbed them. They had run in a circle, but whether by choice or accident I am not sure.

During the next day or two we counted close to one hundred antelope within a five mile radius of the sheep camp where we had been informed of the difficulties we were destined to have to find *one*. The largest single group we saw contained approximately thirty-five animals. This number, of course, is small in comparison with the thousands that have been seen in single bands sixty or seventy years ago, but for this day and this State, the number we saw was very satisfying.

PRACTICALLY all literature on the pronghorn and most old time antelope hunters mention that the antelope's curiosity can be attracted either by lying low and waving a flag tied to a stick, or by lying on your back and kicking your legs in the air. I have tried both, and although the antelope in sight stopped to watch the procedure and showed some interest, none was possessed of a very noticeable desire to come closer to investigate. Antelope in that area are almost impossible to approach very close by anything that looks or acts like a man. They are difficult to trick and the best way to view them at close range is through carefully-planned stalking, by means of powerful field glasses or possibly by the use of blinds.

Of course, in the event of an open season, when shooting at them with a high-powered rifle, it is not necessary to get really close if one's aim is good. But for interested observations and photographs close range is necessary. They have been approached on horseback successfully as long as the rider kept himself fairly well covered by a sheet or a blanket. I have found that the man on foot will be more successful if he conceals himself in tallgrass or some handy topographical feature and waits.

A blind with salt for an attraction is something I have dreamed about, but never quite had the time to realize. A blind is seldom built



Photograph by Charles J. Belden

No healthy baby antelope needs excessive parental care. When a few hours old it can maintain a speed of approximately thirty miles an hour over long distances. This youngster was about ten days old when he was photographed on the Wyoming range.

one day and used the next. It would probably stand a better chance of success if allowed to stand undisturbed for a couple of weeks, or even a month, so that the antelope may gain confidence in its harmlessness.

Incidentally, field glasses are a very necessary item to spot antelope with. With the naked eye I have mistaken distant pronghorns for fence posts, shrubs and boulders. On the other hand, they never seem to have had much difficulty identifying me, standing or lying, even with the wind in my favor.

Mention "antelope" to anyone familiar with the word and "speed" will flash into his mind. The antelope and his speed are as familiar a combination as the grizzly and his ferocity or the elk and his bugling.

After fairly numerous observations there is no doubt in my mind that pronghorn antelope can run approximately fifty miles an hour in a short spurt. But, so far, I have never yet failed to "haul one in" in a two or three mile sprint with an automobile doing forty or a little less. Recently I saw a wild animal movie in which it was stated that the antelope could do from sixty to seventy-five miles an hour. I would like to believe it, but I can't.

Last September a large buck led us a merry chase across a flat. At no time did the old boy seem to be stretching out any faster than thirty-five miles an hour, and he had an anxious eye on our automobile right behind him every time he could find a second to twist his neck a little.

He was the fourth I had raced with an automobile and none of the four ran any faster than thirty or thirty-five miles an hour, which is quite fast enough for flesh, blood and muscle.

When the race was hottest and closest the driver of the car practically sat down on the brakes to prevent a pile-up in a wide gully that suddenly appeared before our noses. We stopped, fortunately, but not Mr. Pronghorn. He went down the gully and up the other side with absolutely no loss of motion. Antelope seem to ignore gullies. If they are too large to leap, the animals simply race down one side and up the other.

By the time my driver had eased the car down one side of the gully and just as carefully climbed the other, our buck was climbing a steep ridge a quarter of a mile away. And when we had cleared the gully and were once

more on the flat, our pronghorn was standing victorious on top of the ridge, looking down at us. If antelope have a sense of humor, he was probably chuckling to himself.

Reliable men have spoken and written about a particular characteristic of pronghorn antelope referred to as his "racing instinct." By this is meant the uncontrollable desire of the pronghorn to run parallel to, and race, any swiftly moving object. Eventually, in a sudden burst of reckless speed, the pronghorn is said to cross under the very nose of his rival. In the days when the prairie was still fairly open they are supposed to have run such races with everything from cow ponies to locomotives.

My experience on the Colorado State Antelope Refuge has been to the contrary. There, antelope seem to have no desire to run parallel to any car. But how they do run *from* one!

In connection with that racing instinct of the pronghorn, I recently had the pleasure of reading a book about an expedition through the Tanganyika veldt of East Africa. I was interested because the author is a Colorado man and I wanted to discover whether he found any similarities between African antelope and our own pronghorn. He described how impallas and wildebeest raced his motor truck and in a sudden attack of speed crossed directly in front of the truck, and while he did not mention the pronghorn, the observation is interesting.

It has never been my good fortune to have seen baby antelope (kids) but men who have seen them say that sharp eyes, knowing where to look and outwitting the mother are the three essentials of the discovery. The antelope doe is among the wisest of wilderness mothers. She has to be if she is able to protect her twins from coyotes, stray sheep-killing dogs, hunters and even eagles.

What I have heretofore considered authentic sources state that the pronghorn baby lacks scent, and that if a kid in a good hiding place lies perfectly still a coyote can walk by within several yards of him, nose working as usual, and not even get as much as a whiff.

Some months ago a magazine article mentioned the belief that antelope kids lack scent and called it "pure bunk." As proof it cites the fact that in the Kaibab region of Arizona dogs are trained for the specific purpose of hunting out the kids (for legitimate reasons),

very much as bird dogs are trained to find game birds.

I cannot speak from experience on that matter as yet, although I hope to make some observations of my own some day.

It has been stated in recent years that the pronghorn is changing his habitat and taking to the higher hills and forests because of unfavorable conditions on the plains. The fact that the Forest Service has been able to compile census figures on antelope for certain national forests is proof enough for me.

That has not, however, occurred in Colorado. The Roosevelt National Forest lies practically adjacent to the Colorado State Antelope Refuge, but the supervisor of the forest as-

sures me that he knows of no pronghorns within his jurisdiction. This appears to hold true for the other Colorado national forests that fringe what is generally regarded as antelope country. An up-to-date game map of Colorado shows that the few pronghorns that are left in the State are remote from wooded areas. The Colorado pronghorn today is found mainly in the north-eastern and eastern parts of the State, and still considers the sunny and windy plains his home.

Those who have seen the pronghorn in hilly and timbered country mention with what ease he is approached when bushes and trees form hiding places for stalkers. No doubt of that. The antelope is an animal of the plains and his hearing is not as keen as that of forest animals because there has been no necessity for its acute development where distances stretch from horizon to horizon. In such country the eyes play the leading defensive role, seconded by a good nose for night purposes.

Conditions on the Colorado State Antelope Refuge are not any too good. The "staggy" appearance of what little brush there is, the great abundance of cactus, and some other ecologically regressive features, point to overgrazing and distress from drought.

There are about five hundred antelope on the area all the year, and quite a few domestic sheep are run there from October until late May or early June. As it is unlikely that vegetation can be seriously harmed during winter grazing when growth is for the most part negligible, seed has long been developed and dropped and the ground is frozen, overgrazing

and mechanical harm to vegetation evidently take place during the season of the greatest vegetative development and soft ground conditions — the spring. And as five hundred antelope cannot possibly compete with several thousand sheep during any grazing season, it seems rather apparent that the overgrazing is done by the sheep.



Colorado State Antelope Refuge - 1935

Although antelope in Colorado have been protected by law for years, there has been no report of any appreciable increase. In fact, they are barely holding their own, which means that one of two things is occurring, or both. Perhaps there are too many quick-trigger men in and around Colorado, or perhaps the pronghorn has been finding the ranges greener in Wyoming and has (contrary to his truer nature) been migrating.

Protection for the pronghorn on the Colorado State Antelope Refuge is fairly weak. The game warden of Larimer County has too large an area for one man to patrol. During the autumn, the open season on deer, elk and bear demands his presence in the mountains. The fishing season also requires his official presence in the mountains. The pheasant season makes him a busy man on the plains, but as the pheasant area is not concentrated very close to the antelope country, it is not easy for him to keep an eye on his pronghorns simultaneously. Economic reasons make it doubtful whether he could appoint enough deputies to cover both the plains and mountains of Larimer County, for since the season is always closed on antelope, the State Antelope Refuge should be

regularly patrolled. As it is, the best the warden can possibly do is visit the refuge hurriedly about once a week.

The antelope has never been as well advertised to the people of Colorado (for no other reason than neglect) as the deer and elk. Consequently, the people themselves are indifferent to the existence of the pronghorn. In a State where pronghorns are as native as the Rocky Mountains, it seems to me that they deserve a better break than that and I feel certain that if the antelope is called to the attention of the Colorado public properly and truthfully, it can make a grand comeback on Colorado's rangelands.

There is some question as to the probable antelope population of North America. The borders of their distributional range have shrunk, but the antelope themselves are generally thought to be increasing within the present smaller area. The western United States is now, and always has been, the region of their greatest abundance. Pronghorns in Canada exist only in the southern parts of Alberta and Saskatchewan; in Mexico they are found in the

States of Sonora, Chihuahua, Coahuila, Durango and Baja California, but supposedly in limited numbers. As information concerning the pronghorn in Mexico is vague, the only safe statement about the status of the antelope in that country is that they exist in small to fair numbers in the States mentioned.

All of our western States but Washington and Kansas have antelope. Four, according to their own figures, have enough antelope to justify open seasons. One State opens the season on an estimate of 33,000, another on an estimate of 9,000, still another on an estimate of 10,500 and the fourth on a pure guess that they have too many. There results what seems to be a discrepancy in State antelope management, even though it must be admitted that the States are generally doing pretty good work in restoring the good status of the pronghorn. A fifth State reports 15,000, but *no open season*; a sixth claims "one of the largest herds in the country," but it likewise says nothing about an open season. When it is taken into consideration that none of the western States is very well populated, there is evidently quite a difference



Photograph by U. S. Bureau of Biological Survey

The pronghorn herd on the Sheldon Antelope Refuge in Nevada comes down to water at Hobble Springs. Water is frequently scarce on the western ranges, especially in the recent years when the drought has parched vast areas in western States.

of opinion between game commissions as to how many pronghorn antelope make too many.

There is very little reason to doubt that antelope are increasing, for every indication points to it, but that they are increasing as greatly as commission census figures indicate is certainly doubtful in view of the adverse conditions confronting the pronghorn today. Such things as bad grazing conditions prevalent on most of our public domain and other ranges, and the undoubted illicit hunting that goes on are important factors not to be overlooked. Furthermore, if the States themselves are unaware of what number constitutes an overabundance of antelope, then the open seasons for which they are responsible might actually be doing them more harm than good as far as the pronghorn situation is concerned.

The outstanding feature of a State antelope census is its incompleteness. Only one out of the fifteen western States that have pronghorns gives a census that *might* be correct, or close to it. The only reason that I have for picking out that exception is that its census figure is a definite, concrete number instead of the round numbers of so-many-thousands, as is the case with the other fourteen States.

A good, dependable census of the pronghorn antelope is desirable from the standpoint of official determination whether an open hunting season is advisable, and if so, for how long.

A comparison of any State antelope census with the one made by the Bureau of Biological Survey³ in 1922-1924 shows a striking contrast in efficiency. Whereas a State census is a mere guess, incomplete and undependable, the Federal census describes all sources of information, weighs each carefully and generally attempts accurate, concrete figures.

In conjunction with the Federal government's current land-buying program in the West for the specific purpose of returning certain areas to their original grazing uses, it might prove very appropriate and desirable to subject all antelope thereon to a Biological Survey census every five years or so. Not only might grazing lands benefit, but the pronghorn would be placed on a sound management basis which would provide for his conservation and unprejudiced future security.

Because our antelope is so strictly a North American mammal, he is deserving of some national distinction in the United States. I am sincere in my hope that within a few years to come we may see established in this country a National Antelope Refuge. By the creation of the National Bison Range, the American buffalo has been so honored—why not the little prongbuck?

³ The Status of the Pronghorn Antelope, 1922-1924. U. S. D. A. Bulletin No. 1,346.



The Haitian Solenodon

Obscurity Still Surrounds the Life History of a Curious Insectivore First Described
More Than One Hundred Years Ago

WILLIAM BRIDGES

A LITTLE more than a hundred years ago, in 1833, J. F. Brandt examined a skin and a damaged skull that had been sent to the St. Petersburg Academy unidentified except for a tag that indicated the objects had been collected on the island of Haiti. The material was not the most satisfactory for such purposes, but it sufficed for a formal description of a new species of Insectivore which he called *Solenodon paradoxus*, and it is a tribute to his skill and care that even today his original description from imperfect material is considered remarkably full and accurate.

Almost three-quarters of a century passed before another specimen of the solenodon came out of Haiti. In the meantime solenodons were described from the island of Cuba and, at first thought conspecific, were eventually differentiated under the name of *Solenodon cubanus*.

Between 1833 when Brandt's description of the Haitian species was published¹ and 1907 when Dr. A. Hyatt Verrill set box traps in the San Domingo forest and captured three specimens for The American Museum of Natural History, scientific knowledge of *S. paradoxus* was virtually a blank, although several references were made to the skin and skull in St. Petersburg. Poey had made mention of the Cuban species in a communication to a Havana paper, *El plantel*, in 1834, and had noticed it more fully in 1851 in his "Memorias sobre la historia natural de la isla de Cuba," and in 1864 Peters described the Cuban species after borrowing the St. Petersburg material for comparison. Still later, in the early years of this century, before the Verrill specimens came out of Haiti, Leche also examined the St. Petersburg skin and skull and some fragments of a

skeleton while preparing his extensive work on the teeth of the Insectivora.

It is in keeping with the obscurity that for so long surrounded the Haitian species that the pelvis and sacral vertebrae that Leche found in St. Petersburg and described as those of the solenodon are not those of the solenodon at all, a mistake that Dr. Glover M. Allen in his memoir on *S. paradoxus*² supposes to have arisen "through some transposition of labels, for Leche himself remarks upon the astonishing characters that the specimen presents, quite different from those of all other 'Insectivora lipotyphla.'"

The first opportunity that scientists had to examine the Haitian species fully came with the arrival of the Verrill specimens. Dr. Verrill himself published notes on the habits and external characters of the animal³ and so did Dr. J. A. Allen, then Curator of Mammalogy and Ornithology at The American Museum.⁴ At about the same time the Museum of Comparative Zoology at Cambridge, Massachusetts, received four living specimens, and five others were brought to the United States by Franklin Adams, Secretary of the Bureau of American Republics, in 1910, the Zoological Park receiving three which died within a week after arrival. The other two were presented to the National Zoological Park in Washington.

The publication of Verrill's and Allen's notes and the Museum of Comparative Zoology memoir at last began to make the Haitian solenodon known to the scientific world, at least, although the poor luck that attended efforts at

² Allen, Glover M. *Solenodon paradoxus*. *Memoirs of the Museum of Comparative Zoology*, Cambridge, 1910, vol. XL, no. 1.

³ Verrill, A. H. Notes on the habits and external characters of the Solenodon of San Domingo (*Solenodon paradoxus*). *Amer. journ. sci.*, ser. 4, 24, p. 55-57, 1 fig. Also *Ann. mag. nat. hist.*, 1907, ser. 7, 20, p. 68-70, pl. 4.

⁴ Allen, J. A. Notes on *Solenodon paradoxus* Brandt. *Bull. Amer. mus. nat. hist.*, 1908, 24, p. 505-517, pls. 28-33.

¹ Brandt, J. F. *Solenodonte*, novo mammalium insectivorum genere. *Mém. Acad. imp. sci.*, St. Pétersbourg, 1833, per. 6, 2, p. 459-478, pls. 1, 2.



I purchase specimens of this animal alive or dead and also all kinds of birds and insects.

Kaufe lebende oder tote Exemplare des oben abgebildeten Tieres, ausserdem Vögel und Insekten.

Yo compro muestras de este animal, vivo o muerto, como tambien todas clases de pajaros y insectos.

J'achete cet animal vivant ou mort et egalement toutes sortes d'oiseaux et d'insectes.

Supplied with hundreds of postcards like this, picturing the solenodon and offering to purchase specimens, Dr. Verrill went to Haiti and San Domingo almost thirty years ago and captured the first specimens seen since early in the past century.

exhibiting it confined it to that dwindling but still large group of animals rarely or never seen in captivity.

The greater part of what has been written about *S. paradoxus* has been concerned, naturally, with technical descriptions of its external and internal characters and Dr. Verrill's comments in the *American Journal of Science* are still the fullest natural history notes available.

"In its habits," he wrote, "the solenodon resembles a hog, rooting in the earth and cultivated grounds, tearing rotten logs and trees to pieces with its powerful front claws, and feeding on ants, grubs, insects, vegetables, reptiles, and fruit, and at times proving destructive to poultry. On several occasions it has been known to enter the houses in search of roaches and other vermin, and has been captured in rat-traps.

"It is strictly nocturnal, and spends the day in caves, holes in the coral limestone rocks and in hollow trees and logs. It is a slow, stupid creature. It is unable to run rapidly, but shambles along with the zigzag, sidewise mo-

tions of a planigrade. It is doubtless owing to this that it obtained the native name of 'Orso' (bear).

"Its long snout and stout front feet, with their curved claws, and its thick, short neck, prove impediments to forward progress. According to the natives it is incapable of running straight. They also claim that when pursued it frequently trips itself and tumbles heels over head. When hunted with dogs it thrusts its head into the nearest hole or shelter and allows itself to be captured without resistance."

Dr. Verrill, who now lives in New York, recalled further circumstances of his capture of the first living Haitian solenodons in a talk with the writer.

"In December, 1906," he said, "I undertook a collecting trip to Haiti and San Domingo for the Kny-Scheerer Company of New York, dealers in natural history specimens. I had a double purpose—to collect birds and solenodons, the latter particularly for The American Museum of Natural History.

"The capture of solenodons very soon became my chief aim. There were comparatively few difficulties about the birds, and so much emphasis was put on the unlikelihood of my finding solenodons that they assumed first place in my mind. Several prominent zoologists assured me that my quest was hopeless. There was even a belief that the Haitian species was extinct, and one man told me I would be as likely to capture specimens of ghosts as of *Solenodon paradoxus*.

"Experience in these matters had taught me the difficulty of describing a bird or an animal or a reptile to natives and making them understand the exact thing wanted. Therefore, before sailing for San Domingo, I searched books on natural history and from Brehm's old 'Natural History' I culled a drawing of the Cuban species of solenodon. It was, I thought, sufficiently similar to the Haitian species to serve my purpose.

"I had several hundred small cards made up, reproducing the drawing of the Cuban solenodon, and I had an announcement printed on the card in English, German, Spanish and French, saying that I wanted to buy animals like the one in the picture, dead or alive.

"My first move on arriving in the island was to start distributing those postcards. I gave them to everybody—people on the street, country laborers, boatmen, virtually everybody I met as I travelled over the island.

"The country people especially appreciated the cards. Pictures of any kind were rare with them in those days, and I could be sure they would save the cards, perhaps show them to their friends, and certainly talk about the man who wanted to buy the animals. Word did, indeed, get around the island in a hurry that I was looking for the 'Orso.'

"In some parts of the island I found the animal was absolutely unknown and I am inclined to the opinion that its range is pretty definitely limited. I did, however, find a district where it was well known, for a great many persons recognized it instantly when I showed them the picture and fellows began coming in and saying they could show me where to get the animal.

"One man was so positive that he knew where there were bones of the solenodon that I made a long trip with him, through a mangrove swamp

and into a cave. There were bones, all right, but they were the bones of a hutia, instead of a solenodon.

"Not long afterward a black man told me his dogs had recently killed a solenodon and I examined what was left of the beast and found that it was really the solenodon. Once I had located the area where solenodons were frequently seen, it was simple enough to catch specimens. I set box traps and baited them with chicken heads, and managed to catch three—an adult male, an adult female and a young specimen.

"Not long after I caught the female she gave birth to three young, but she killed and ate them almost immediately."

As Dr. Verrill recalled it, he set his box trap in the forest in a small area where there were plenty of signs of solenodons having hunted food recently.

"It was easy to trail them through the forest," he said. "Their powerful claws are used to tear up rotting wood in search of insects and grubs, and they left a trail of scattered debris behind them.

"They are fond of land crabs, too, and if you came upon a pile of torn crab shells, you could be sure that a solenodon was living somewhere nearby.

"The natives told me solenodons live in hollow trees and particularly the cecropia tree, but I examined scores of those trees and never found a solenodon but once. My black man was lying on the ground in front of the opening in a hollow tree, trying to stir out anything that might be inside. A solenodon scrambled out and waddled across the Negro's chest. I couldn't fire for fear of hitting the man, and the animal escaped into the bushes.

"As I said before, the three specimens I caught were taken in box traps baited with chicken heads. The planters told me the animals sometimes killed their chickens. They will eat vegetables, too, and sometimes do a good deal of damage to a garden. I should say, though, that they are ninety per cent. insectivorous."

Dr. Verrill is not willing to call the solenodon a rare animal—in Haiti—no matter how few have found their way to exhibition or museum examination in the United States. The mon-

goose, swift and vicious foe of such an easy-going animal as the solenodon, has undoubtedly reduced its numbers and may eventually exterminate it, but Dr. Verrill saw two solenodons crossing the road ahead of his automobile last spring near an old plantation at Sosua, and many times in recent years he has heard of specimens being in captivity in Haiti and San Domingo. Generally, however, they lived but a short time, perhaps because they were caged too closely, teased or improperly fed.

Few have been offered by animal dealers, although some years ago the New York Zoological Park and various other zoological institutions were offered one specimen by a native of San Domingo for \$30,000. One and all, it is needless to say, declined the offer.

A few weeks ago another native collector, with a considerably more modest idea of the animal's value, offered two solenodons to Dr. Blair and

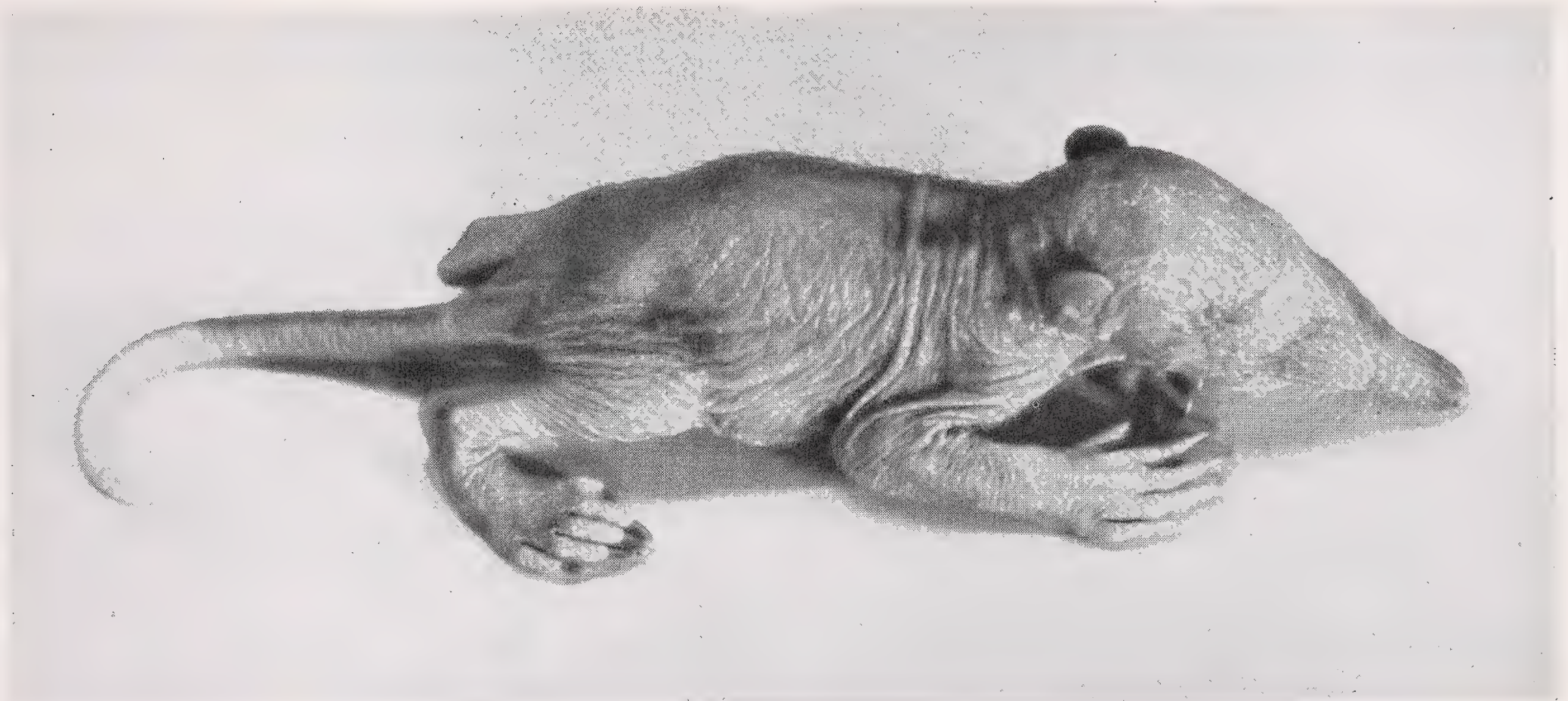
they were purchased, arriving in New York on December 9 in excellent condition. They appear to be a mother and almost fully grown son.

Because the temperature and humidity of the Reptile House are constantly maintained at approximately tropical levels, the animals were installed in a large cage there. They took kindly to captivity and showed no fear either of visitors passing in front of them or of the keepers who cleaned their cage and presented their food of chopped meat. Most of the daylight hours they spend curled up asleep, but they become quite active at dusk and marks on the front of the cage indicate that they move about freely during the night.

None of the keepers in the Reptile House has heard the animals make the shrill cry that, according to Dr. Allen's memoir, they occasionally utter, nor the "explosive sniff as if clearing the nose" that has also been described. Dr. Allen



When the photographer gave the Park's Haitian solenodon an old stump as a background, the animal spent an enjoyable fifteen minutes exploring its minutest crevices in search of insects that might still be lurking in the dry wood.



And this is the baby solenodon, a wrinkled little creature that resembled nothing else so much as an infant elephant. Its eyes and ears were not yet open but it was able to crawl clumsily about the nest of straw built by the mother.

noted in the live specimens kept for a time at the Museum of Comparative Zoology that they were capable of quick movements when two or three were eating together and disagreed over the possession of some morsel of food.

"If one attempts to rob another, like a flash the possessor of the dainty throws its body around away from the pursuer and continues chewing greedily."

Keeper Fred Taggart has observed that behavior in the Park's specimens, and has noted that they often bare their teeth at each other—and at his hand, when he sets a tray of meat in the cage—but they have never actually attempted to bite.

Dr. Verrill also remarked on their peacefulness. When his specimens were trapped, his native helper thrust his hand into the cage and drew the animals out without being bitten.

The day the two solenodons were installed in their cage in the Reptile House, a small box about fifteen inches square was set in one corner as a shelter from light. The floor of the cage was covered with hay.

On December 23, two weeks after arrival, unusual behavior was noticed. During the night the female scraped a quantity of hay into the small box and partly walled up its open side. Since the animal was completely hidden from exhibition, a keeper pulled part of the hay away.

The following day the same thing was repeated. On December 26, at 10.30 A.M., Keeper Taggart opened the cage to clean it just as a young solenodon was being born. During the night the mother had once more dragged hay into the box and had made herself a deep nest.

Inasmuch as there were only two previous records of solenodons born in captivity—the three born to Dr. Verrill's specimens, and one born at Cambridge, which died after three days—every precaution that could be thought of was taken to favor the existence of the baby. The nest was carefully built up and not disturbed in cleaning the cage, the other adult animal was removed to another cage for fear it might trample the baby, and the mother and her offspring were kept in perfect seclusion.

Nevertheless, a few glimpses were obtained of the youngster. The baby was almost bare of hair, although it possessed rather long vibrissae on its long snout, and it seemed quite active in tumbling around the small circumference of the nest.

The mother made no attempt to destroy it, as had been the case with the Verrill specimens and, indeed, seemed to try to teach the baby to nurse. It was blind and the ears were not yet open.

On the morning of December 28, just forty-eight hours after birth, Head Keeper John



The tenrec of Madagascar is the nearest, but still distant, relative of the New World solenodon and both are probably survivals of primitive types.

Photograph by R. L. Ditmars

Toomey found the baby lying outside the nest, the mother being inside. It appeared to be dead but he discovered on examination that it was still alive, and placed it back in the nest beside the mother. Two hours later the baby was again outside the nest—this time dead. Its power of movement was so slight that there can be little doubt that the mother cast the baby out of the nest.

No autopsy was made at the Park, since the baby was sent to The American Museum of Natural History for detailed study, but it is believed that it had failed to take nourishment.

The mother showed no concern over the loss of her offspring. The adult male was returned to the cage and the life of eating, sleeping and nocturnal activity has been resumed.

A word remains to be said about the zoological relationship of the solenodon—a relationship that is as curious as the animal itself. Dr. J. A. Allen describes it as “the sole genus of the family Solenodontidae, which finds its nearest living relatives in the family Centetidae, confined to Madagascar and some of its outlying islands, thus an equally isolated group. Both are commonly regarded as survivals of primitive types, whose ancestral history remains to be discovered.”

Other authorities also relate the solenodon distantly to the tenrec of Madagascar—a relative remote in space as well as time, since they live almost on opposite sides of the earth.

As far as could be learned, the male and female solenodon in the New York Zoological Park and a pair on exhibition in the National Zoological Park in Washington are the only solenodons in captivity in the United States at present.

Dr. William M. Mann, the director of the latter institution, wrote recently that the first Haitian solenodons exhibited in the National Zoological Park were two received on July 23, 1910. One died on August 11, 1910, and the other on January 6, 1911.

The present pair was received on October 15, 1935, and at the time of writing, January 7, 1936, was alive and feeding on egg and milk and cut-up beef.

“It is interesting to note,” he added, “that in 1910 when exhibiting the solenodons we had at the same time a tenrec in the collection.”

The Philadelphia Zoological Garden had extraordinary success in keeping a Cuban solenodon on exhibition. In December, 1886, a specimen was received and it lived until July, 1892, a period of five years and seven months.

New York "Manages" Her Fishing Resources

A Long-Range Survey of the State's Waters Is Providing Data for Scientific Restocking

EMMELINE MOORE

Chief Aquatic Biologist

New York State Conservation Department

[In 1869 the New York State Fish Commission compiled a list of lakes in the State and since that time no general study of the inland and boundary waters was made until the Conservation Department in 1926 embarked upon a thorough, twelve-year investigation that is now nearing its end. In this article the author sums up the aims and accomplishments of a project that will enable the State to carry out a really effective policy of fish conservation.—EDITOR]

THE Conservation Department's biological survey of New York State, now in its eleventh year, was initiated in 1926 when the Conservation Fund was established. It was one of several activities designated in the law for which appropriations from this fund could be made to carry forward needed projects in conservation¹. The Conservation Fund provided the financial means in the Division of Fish and Game to push forward a program of study of all the waters of the State, including streams, lakes, ponds and boundary waters. The especial and long standing need was for a stocking policy based on adequate scientific data so that the planting of fish throughout the State's waters might be carried forward more intelligently and economically. The development of such a stocking policy has been the consistent aim and purpose of the survey.

At the outset in 1926 a long-range program was projected. The nineteen major stream systems in the State were grouped into twelve watershed units, one of which each year was to comprise the annual stint in this continuing twelve-year program. The watershed as a unit was adopted because of the nature of certain major problems impinging upon a stocking policy, such as pollution, basic problems in fish population and distribution, the impounding of

waters in hydro-electric development, municipal water supplies, the influence of canals, problems in commercial fishing and the like—in all of which greater continuity and comprehensiveness are attained by attacking the watershed as a whole. The progress made is shown by reference to the map (p. 23), the dates indicating which watersheds have been studied. The Lower Hudson watershed is the next unit area on the program of the survey and it is proposed that the entire State shall be covered by 1937. In carrying forward this long-range program the scientifically based stocking policy has been effected in each of the watershed areas as rapidly as the studies have been completed.

The water areas of the State are a great and valuable resource. In the ten large areas now completed, the survey has covered 55,926 miles of streams, 15,279 miles of which are suitable for trout. By estimation there should be in the State about 65,000 miles of streams. In lakes and ponds 1/65th of the area of the State is water, or about 733 square miles. And to this must be added, also, our frontier or boundary waters estimated at about 1,240 miles (540 miles of our inland boundary waters and 700 miles in the marine district surrounding Long Island). Of fishes there are in the State's inland waters about 175 different species, nearly 20 anadromous species and about 260 salt water species entering the marine district.

No state in the Union possesses a greater or more varied fishing endowment in angling waters than New York, yet this is the first comprehen-

¹ Until 1933 the Conservation Fund consisted of one-half of all monies accruing through the sale of hunting, fishing and trapping licenses. The term now applies to all of the resources received by the Division of Fish and Game.

The illustrations accompanying this article were furnished by the New York State Conservation Department.



sive, state-wide survey undertaken since the establishment of the Fish Commission in 1868. Very early in the history of the Commission (1869) the attempt was made apparently to compile information of the fisheries resources in a state-wide program. A list of lakes was issued by counties (totaling 647 for the State, comprising 466,457 acres). Nothing, however, in the nature of a state-wide study appeared after this initial effort, the list being used thereafter as a convenient reference in the distribution of fish without having the essential information as to suitability for the species introduced.

In the survey program of each watershed unit now under way, the formulation of a stocking policy calls for the accumulation of a vast amount of data. Emphasis is placed on those aspects which are fundamental: on studies of temperatures, the abundance of natural food, the depth and flow of water, the oxygen relations, the minnow life, the distribution of species, life history studies, the presence of incompatible species, pollution conditions, vegetation and plankton and occurrence of disease. All of these and more, including the fishing experience in the locality, are important in determining the suitability of water for the stocking of various species and the numbers that should be stocked. As progress has been made and experience gained, the scope of the surveys has broadened and the character of the investigations intensified with increasing emphasis on such problems as the improvement of forage conditions, the control of undesirable fish, the results of overstocking, the growth rate of fishes, the improvement of stream and lake environments, conditions affecting the increase or decrease of natural propagation and so on. These are but a few of the outstanding problems re-

quiring much more intensive experiment and research if the fisheries resources of the State are to be managed to provide a constantly increasing yield.

The first survey undertaken ten years ago was a relatively small project including the Genesee River system. Twelve scientists were placed in the field and the survey was completed in the three summer months. More than 3,000 miles of streams and several lakes and ponds in the system were studied. Of this stream mileage several hundred miles were found to run dry during the summer and were useless for stocking, a situation resulting largely from the nature of the terrain, a hilly country largely given over to agriculture. The Genesee River in its middle and upper stretches provides particularly good small-mouthed bass waters. Some of the tributaries have notably fine trout waters.

The initial project set standards for methods of developing a scientific stocking policy through the evaluation of environmental conditions affecting fish life. Among the personnel were professors, instructors and graduate students recruited from the educational institutions of the State on release from their regular term-time responsibilities. The report carried discussions explaining the stocking policy as recommended. Maps, charts, graphs, colored plates of fishes and photographs supplemented the papers. The basic studies, necessarily incomplete due to the limitations of time and personnel in relation to the area covered, have expanded as shown in the succeeding survey reports.

The second survey, of the Oswego watershed, was more than twice as large, with a stream mileage of 7,000 miles. Only 1,680 miles were found to be worthy of stocking. This watershed includes the seven Finger Lakes and Oneida Lake, aggregating approximately 290 square miles. Each of the Finger Lakes is a deep glacial valley, the reservoir of a vast volume of naturally pure, cold water supplied by underground springs and inlet streams. The great diversity of beauty existing in the valley slopes and the accessibility of the lakes combine to make this region a distinctive recreational area, providing in its angling resources chiefly trout, lake trout, whitefish and bass. Oneida Lake is notable for the richness of its

"No State in the Union possesses a greater or more varied fishing endowment in angling waters than New York."



(Left) The mobile units of scientists set up field camps in the areas where they worked. (Below) Seining a brook trout pool to obtain quantitative data in a 200-foot stretch of Trammel Creek.

fish life, particularly for its pike-perch fishery and for its bass and pan-fish species. The size of this undertaking, with field work requiring to be completed in the three summer months, necessitated the organization of a large and expertly trained personnel. A staff of forty scientists, including an ichthyologist, fish culturist, biologists, chemist, botanists and limnologists was engaged. It was organized in mobile units, each with a group leader and assigned to special studies on the streams or lakes of the watershed with working plans coordinated to bear directly upon the practical problems of the fisheries throughout the watershed.

In this watershed, studies on the predatory lamprey received special attention. A follow-up program growing out of the survey of Oneida Lake dealt with carp control studies, continued thereafter through a period of four years. Attention was focused upon the scientific and practical aspects of the problem, such as spawning habits, migrations, food, rate of growth, productivity, interference with game species, etc.



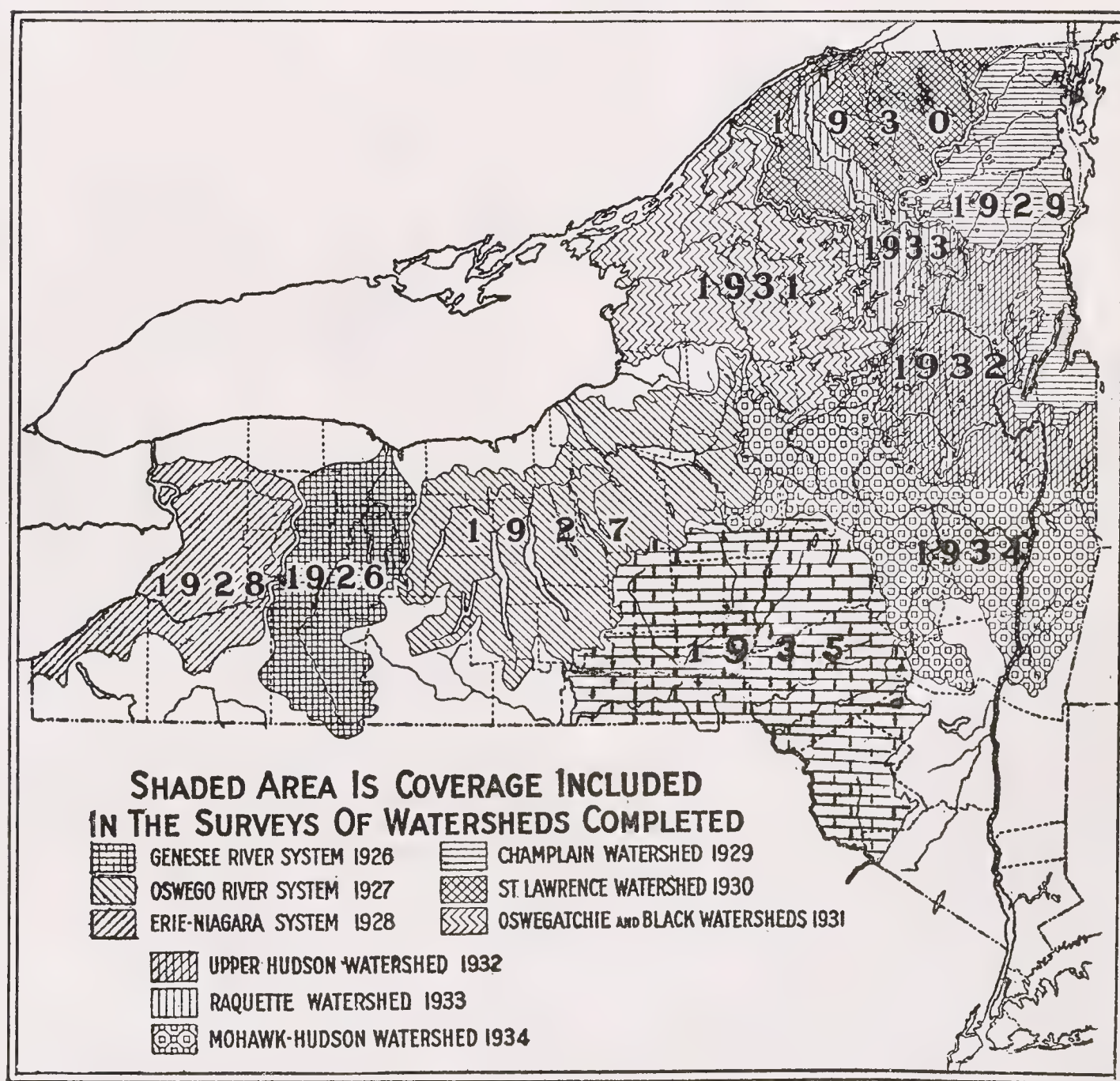
The survey area of the third year included the Erie-Niagara watershed. This area introduced the new feature of cooperation with the United States Bureau of Fisheries and other interested agencies in an effort to develop a unified program for the restoration of the dwin-

dling cisco fishery of Lake Erie. The Federal boat, *Shearwater*, and her crew were assigned by the Federal Bureau to the Department for the summer as its part in the cooperative arrangement. A personnel of forty scientists was recruited under the joint auspices of the United States Bureau of Fisheries, New York State Conservation Department, the Ontario Department of Game and Fisheries, the Health Department of the City of Buffalo and the Buffalo Society of Natural Sciences. The investigations included a three months fisheries survey of the deeper waters of eastern Lake Erie.²

The general results of the biological survey of eastern Lake Erie during the summer of 1928 and continued in 1929 indicated that no untoward conditions in the environment or insufficiency of the food supply could be brought forward to explain the sudden decline of the cisco fishery and its practical extermination in 1925. There was, however, accumulating a wealth of data amassed by the United States Bureau of Fisheries that seemed to bear down upon the facts with compelling weight. Searching inquiry was being made into the methods and intensity of fishing effort, analysis of size groups, growth rate and life history studies. Comprehensive investigations and experimentation had been under way on the efficacy of gear. All gave indubitable proof in the final analysis that the Lake Erie cisco was commercially exterminated through the use of the bullnet, a deep gill net of approximately twenty-four feet depth, designed originally for the cisco.

In the survey of inflowing streams into eastern Lake Erie and the Niagara River, of which there are

3,300 miles entering from New York State, the usual basic data were collected to serve in formulating a stocking policy for these waters. Because of unsuitable conditions in one way or another only 527 miles are listed for stocking. Of this the major stream length is worthy of trout, the lesser mileage being suitable for bass and pan-fish species. Along the lake shore where spawning occurs, abundant young were found in the sheltered bays, in lagoons at the mouths of creeks and in the great weed beds of the upper Niagara River. In regard to pollution, the shore studies indicate that the entering pollutants exert a deleterious effect about the points of entry into the lake but the wastes are soon assimilated by the great volume of lake water. From Buffalo northward, however, the shore effects from the city sewage are severe for a distance of several miles on the New York side of the Niagara River. Eventually these conditions are improved by the cumulative effect of dilution by the great volume of



Only a small section of New York State remains to be surveyed and in 1936 the studies will cover the lower Hudson area and the Croton and Ashokan water systems.

² Preliminary Report on the Co-operative Survey of Lake Erie by C. J. Fish, *Bull. Soc. Nat. Sci.*, Vol. 4, No. 3, 1929.

water in the river and the unparalleled means for aeration and assimilation provided by the falls and rapids.

During the years from 1929 to 1933 inclusive, the surveys covered the five great watershed units whose headwaters lie in the Adirondack plateau. The map indicates the extent of this vast undertaking. It is an area exceedingly diverse topographically and characterized by fishing waters of great extent and variety, including warm waters of open and wooded lowlands and cold waters of the mountain districts and wilderness areas. Within the most elevated region are numerous private park-like holdings, the properties of estates, clubs and lumber companies, whose owners for the most part facilitated the investigations. In some instances access to the larger private properties afforded means of studying waters typifying primitive conditions as to fish life, with authentic records carrying back to a period before the introduction of non-native species in the Adirondack waters.

In this region are the great angling waters of the State, including approximately 22,700 miles of streams of which 7,175 miles are suitable for trout, and nearly a quarter of a million acres of lakes and ponds of which about 86,000 acres are natural trout water. Unfortunately much of the trout water has suffered through the introduction of yellow perch, small-mouthed bass, pike-perch and northern pike. Accord-

ing to Fred Mather,³ who reported upon Adirondack fishes in 1882, these species were not then present. With the advent of these lowland species the angling resources of this region have been profoundly affected.

One of the main objectives in this later survey of these Adirondack waters was a study of the present relationships and adjustments resulting from the introduction of the lowland species. In many instances they have become dominant at the expense of the native trout. Through predation the native minnows and other natural forage species have become greatly depleted. The destructive influences are continuous, eventually affecting the introduced species themselves through over-production and consequent dwarfing or stunting of size.

In connection with studies leading to improved stocking practices, a number of problems received more intensive study as bearing on the general problem of maintenance and improvement in the fishery. Of such problems the following are listed:

1. Studies of the smelt in relation to its importance for stocking as a forage fish. The easy adaptability of this marine species in our

³ Mather, Fred. Memoranda Relating to Adirondack Fishes with Descriptions of New Species from Researches made in 1882. IN: Report on Adirondack and New York State Land Surveys by Verplanck Colvin, Senate Doc. 48, App. E. 1891, p. 125. First published as a separate in 1884; a second reprint appears in 1886; a third (revised) in the Report of Commissioner of Fisheries, New York, 1889, this being the 18th Report transmitted to the legislature in 1890 as Assembly Document No. 14, pp. 124-182.



Two races of smelts occur in Lake Champlain, differing markedly in size. These two are both three years old and the larger is 9 inches long, the smaller 5.7 inches.

The difference is important because of legal size limits and stocking policies.



Scale of a Forked Lake brook trout six years old, showing the winter marks, 1-5. Magnified about 45 times.

inland fresh water lakes has lead to its frequent use for stocking purposes as food for other fish. It is a predator. In Lake Champlain two races occur, differing markedly in size: an indigenous form of larger size and a stunted form derived from marine stock in recent plantings. This variability in size has an important bearing on the legal question of size limits and on the selection for stocking purposes. The need of further study as regards faunal relationships is well illustrated by the situation which now obtains in the Finger Lakes (Canandaigua) where the spawning runs have increased to such an extent as to require measures of control.

2. Studies of control of the common sucker. This species is of distinct value as a forage fish. In trout waters now populated by warm water species it follows that the native minnows become rapidly depleted and the adult suckers, too large to be utilized as food by the predators, provide in their young an important food supply. In unusual cases, as may happen in waters

inhabited by trout, suckers may become serious competitors as a result of over-fishing for trout, the consequence being an upset in balance due to the progressive increase in numbers of the suckers. Measures for dealing with the situation will depend on the physical and biological conditions present. In one situation the appropriate measure for dealing with the problem may be a more generous stocking of trout, in another it may be necessary to thin out the sucker population. No blanket program can be given for their control.

3. Investigations of the rate of growth of fishes. The age of a fish may be determined by means of the scales, the number of winter marks, annuli or growth cessation marks on the scale representing the winter seasons that have been passed. By these studies information is gained of the growth rates of fish under different environmental conditions, their longevity, age at maturity and the period required to attain legal size. By comparison of different waters from which age determinations have been made it is clear that dwarfing and stunting appear where the competition in the food supply is severe either by an over-crowding of the game species themselves or by other associated species. Low temperatures and other unfavorable conditions in the environment may be additional limiting factors.

The survey of the Mohawk and mid-Hudson in 1934 extended the area of investigation from the southern slopes of the Adirondacks to and including a part of the Catskill plateau. It included also the eastern highlands of Rensselaer and Columbia counties. More than 8,600 miles of streams and about 28,400 acres of lakes and ponds lie within the region. Trout water is represented by 2,077 miles, of which 186 miles are posted at this writing.

Coincident with the studies dealing with the stocking policy, an expanding program of stream improvement with C.C.C. labor has been carried forward on streams on State-owned land. Growth-rate studies were continued on a larger scale on trout and bass in waters of slow and rapid growth as an aid in management problems. An intensive study of the water chestnut (*Trapa natans*) in the Mohawk River and now spreading into the Hudson supplied fundamental data for the control of this objectionable weed. Life history studies were completed for two impor-



Pine Brook, a tributary of the Raquette River, was flat and shallow and unsuited to the needs of brook trout when the New York State Conservation Department's biological survey examined it with a view to stocking it with game fish.

tant fish parasites, the black grub of bass and the yellow grub of bass.

The survey of the Mohawk River was an initial effort to assess this historic stream from the standpoint of its fishing value. The cities and villages of the highly industrialized valley have long disposed of their sewage and industrial wastes by the simple expedient of dumping them into the river. Recently public opinion has pressed for more decent disposal methods. The nearly complete canalization of the river in 1918 as a Barge Canal greatly altered the water course. The construction of nineteen dams and locks has largely obliterated the riffles, weedy coves and pools of the natural stream so that levels resulting from the construction of dams and locks with a relatively uniform depth have become settling basins of organic wastes from

the industrial centers. In several of the levels only tolerable conditions exist for fish life. Fast water in the canalized portion of the river is now limited to the area immediately below the dams where in times of abundant water a gate or two may be opened and provide considerable current. Except in the "lakes" or widewaters, fishing for the game species at the present time is largely limited to these small areas below dams.

The State has a large investment in canal lands extending throughout this populous valley, a region characterized by great scenic beauty. With improving conditions following better disposal methods, new uses for recreation are possible. A betterment of fishing conditions and other outlets of recreative value may well receive attention to serve the 523,000 people oc-



Small dams, deflectors and shelters were constructed in the course of the brook and trout readily took advantage of the improved depth and shelter conditions. This picture shows a section of the brook after a deflector had been built.

cupying the congested industrial centers which are established along the banks of the river in its course of 113 miles from Rome to Cohoes.

The Delaware-Susquehanna survey, completed in 1935, brings the survey program up to date. The area comprises the entire Delaware system and the major part of the Susquehanna (North Branch). It embraces the extensive highland region of the southern and western slopes of the Catskills and the northern Appalachian plateau. The elevations attain 3,300 feet above sea level.

This area is an outstanding region in the State for stream and river fishing. Native trout, now largely restricted to the headwaters, are widely distributed in both systems. The trout streams of the Beaver Kill, Willowemoc and the Neversink are famous for brown trout fishing.

Lake Otsego is widely known for its lake trout and whitefish (Otsego bass). The warmer waters are unusually productive for bass, pickerel and wall-eyed pike. The approximate mileage of streams in the Delaware watershed is 3,273; in the Susquehanna, 6,838. Of the total mileage in the Delaware, more than half the mileage is suitable for trout; in the Susquehanna, one fourth is trout water.

The studies on the distribution of fishes disclose a list of species and sub-species totaling 62 forms, comprising important food and game fish, forage and bait species and a few of unusual occurrence in the State that enter from southern waters. Shad and sea lampreys ascend the Delaware from the sea to spawn in the river or its tributaries. Dams in the course of the Susquehanna prevent the ascent of these spe-

cies. The most abundant fish of the region is the common sucker, although a number of different species of minnows are but slightly less numerous. Eighty-five lakes and ponds in the drainage were studied to formulate for each body of water a policy in management consistent with chemical, physical and biological factors operating in the lake or pond.

The results obtained by the limnologists⁴ studying Otsego Lake may be mentioned here because of their bearing on the fundamental question of productivity.

Otsego Lake lies at an elevation of 1,194 feet. Its length is eight miles and its maximum depth is 168 feet. Its surface area is 4,265 acres and its volume was computed to be 14.596 million cubic feet. The cold bottom water, which remained practically constant throughout the summer (41.4—51.5 F), was abundantly supplied with dissolved oxygen (8.4 p.p.m.), an important essential in the environment of the lake trout and whitefish population of the lake. Favorable alkaline conditions also are present, the methyl orange alkalinity testing 100 parts per million.

The amount of heat distributed by the wind and absorbed by a body of water is a vital factor in the productivity of a lake, hence the heat budget for Otsego was estimated. Calculations for August 9, 1935, showed a heat budget of 24,500 gram calories. In heat income this lake belongs to those of the "first class," comparing well with the productive Finger Lakes.

Quantitative determinations were made also of the plankton, which consists of the microscopic free-floating plants and animals in the water. Plankton is the natural food of all young fish and the food of several fish species throughout their adult life. The quantitative estima-

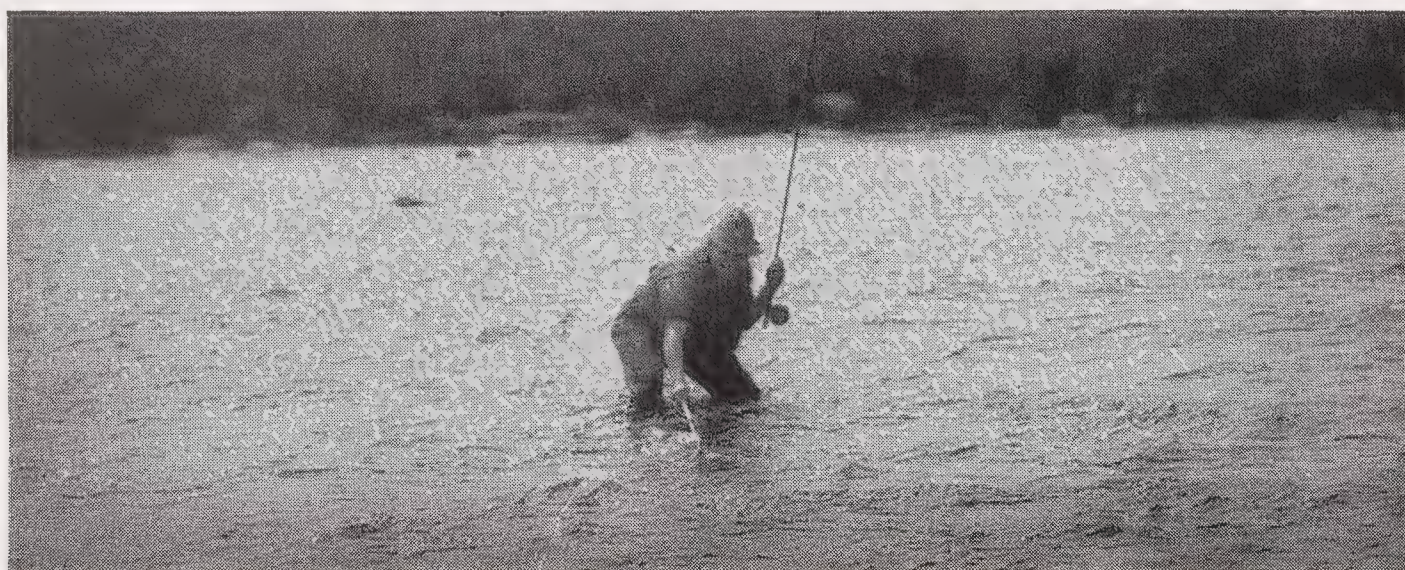
tions reveal for the period a crop of plankton attaining 170 pounds per acre of dry organic matter. When one considers that the living organisms would have amounted to ten times as much, the crop per year reaches very large proportions. Important pioneering research is needed on the utilization of the plankton crop by the numerous organisms concerned in the chain of food relations of fish.

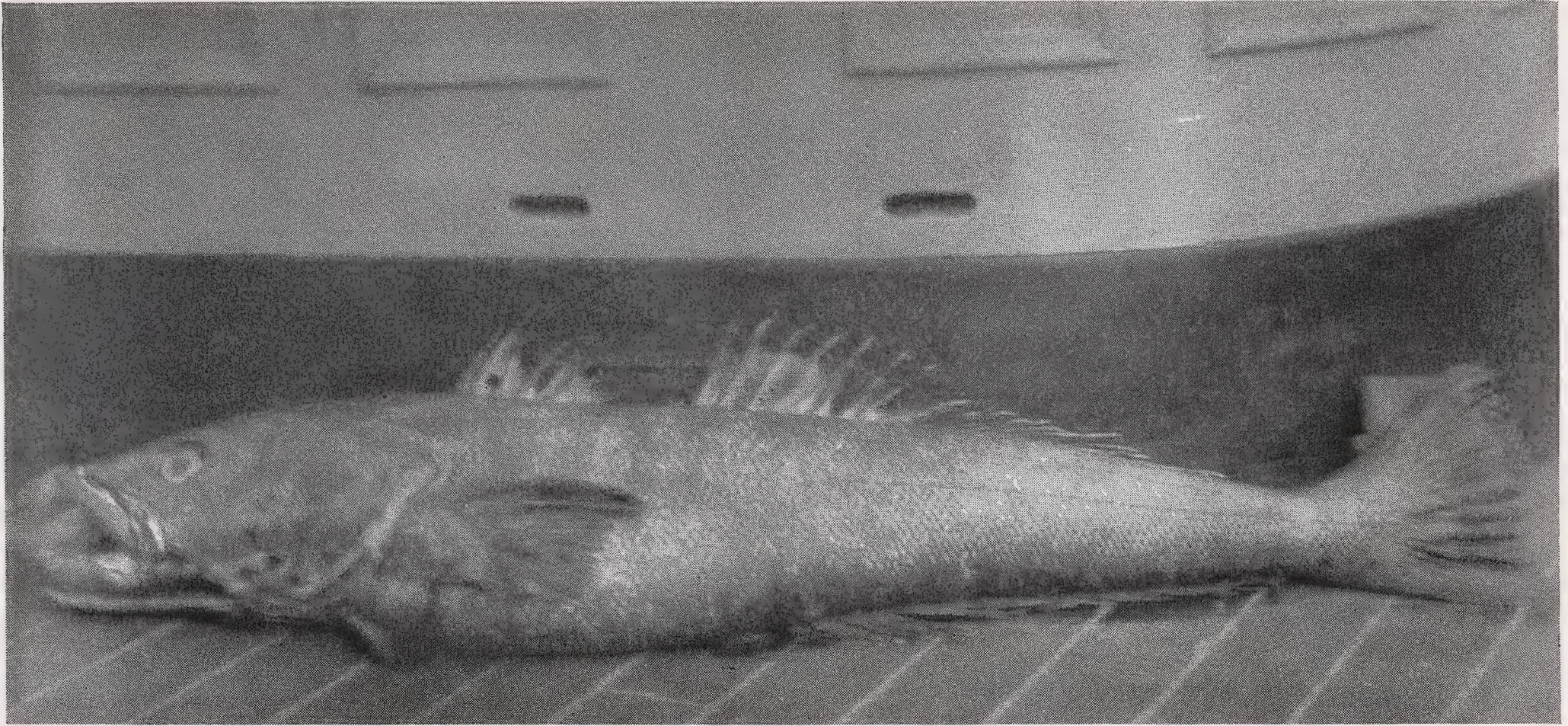
The eleventh survey and the final twelfth will carry the investigations into the remaining inland waters of the State. In 1936 the studies will cover the lower Hudson area with special studies of the fish life in the river, the extensive reservoirs of the Croton water supply, the Ashokan reservoir and the streams and lakes of the region.

In this brief résumé of the surveys it is clear that Nature does not repeat herself even in watersheds. Each of the great drainage systems of the State has presented its special problems. They have been dealt with as fully as the limited time for field work would allow. To an unusual degree the scientific data has been related to the practical problems of the area and the initial objective, a scientifically based stocking policy for each of the watersheds, is being accomplished. The investigations have broadened in scope as progress has been made, to include subjects of a more general nature in the field of fisheries management.

The separate published reports in this State-wide survey provide information on a wide range of matters pertaining to fish life. They have been the means of extending important co-operation between a State agency and the educational institutions of the State. As a reconnaissance of State-wide conditions they should serve as a blueprint in framing objectives for a long-time program of research.

⁴ Report in press.





Macrias amissus Gill and Townsend

The Largest Deep-Sea Fish

A Long-Missing Photograph of the Monster Comes to Light After Nearly Half a Century

C. H. TOWNSEND

IN 1901 the late Dr. Theodore Gill and I published in *Science* (Dec. 13) a two-column article entitled "The Largest Deep-Sea Fish," which we had named *Macrias amissus*, referring to its large size and the loss of the specimen.

The description was based on a photograph, the specimen from which it was made having disappeared. We announced that the photograph would be published by the United States Commission of Fisheries, but this was never done. Dr. G. S. Myers, assistant curator of the Division of Fishes at the United States National Museum, recently has written me inquiring about the possible existence of the photograph. A search among old records of the voyage of the *Albatross* in 1888, which I had preserved, brought to light the long-missing photograph which is reproduced herewith. It will doubtless be of interest to ichthyologists.

The publication of our description in 1901 aroused some comment as to the propriety of naming a fish of which we had no specimen. The fish was dredged off the coast of Chile from a depth of 1,050 fathoms, a thousand feet

deeper than a mile. The scientific staff of the *Albatross* was amazed at its size—so much larger than anything from the depths that we had ever seen. There being no container large enough to hold it, I placed it in a rough box and covered it with some old rusty salt temporarily, until provision could be made for preserving it. Alas for my hopes! The bo'sn's mate, an old man-of-war's-man, eternally possessed with the idea of keeping things ship-shape, pitched it overboard. We never got him educated to the point of regarding the "mess" made by naturalists as anything else than "dirt."

Dr. Gill and I thought the fish as shown in the photograph was about five feet long. Considering the width of the pilot house, I am now inclined to think it was longer.

Macrias amissus never found its way into the published lists of fishes known to science. Perhaps the ichthyologists will relent when they see the photograph Dr. Gill and I regarded as that of a new fish from the depths and worthy of being described as something new to science,

whether we had or had not, the type. We should, of course, have reproduced the photograph at the time.

Had the big *Macrias* been less bulky it would have been passed into the laboratory along with other deep-sea plunder from the same haul. Left on deck in his unsightly coffin, he got a hasty burial at sea, with the bo'sn's mate officiating and most likely, from what I recall of his manners, with a—

“Yo heave ho and fare ye well,
Many fathoms along on the road to h—l,”

but I was not present at the obsequies. Needless to say, had I known what was impending, the bo'sn's mate would have been placed under strict orders that even he would not disregard.

Sometime when I write a book I have always intended to write, about my ten years of service with the *Albatross* in all seas, there will be more tales about old salts and why they need watching. I should like to make several dredge hauls a thousand fathoms deep off the coast of Chile in exactly South latitude $45^{\circ} 35'$ and West longitude $75^{\circ} 55'$.

Rarities in the Park's Bird Collection

Sometimes There Is a Romantic Story Behind the Acquisition of Unusual Specimens

LEE S. CRANDALL

RARITIES form the backbone of every collection, whether it be one of buttons, postage stamps or zoological specimens. Without them the rest of the assemblage lacks flavor; with them, the whole series achieves a higher level.

The birds in the Zoological Park include more than 700 species. For the general educational purposes for which they are maintained, it is probable that their relative scarcity or abundance has little bearing. The most easily obtained species often has great value in arousing latent interest; the perky green shell parakeet, bred in thousands in the aviaries of California, never fails to receive the praise of the uninitiated for its delicate grace and beauty. Yet visitors familiar with these birds pass by the common green form in favor of its seemingly endless color varieties developed in captivity. Twenty years ago it was the blue; then followed the cobalt, the mauve, the white and now the gray-wing. So it is with birds less well known; there are always connoisseurs with eyes only for the strange and rare. To satisfy them, species of this category must be included. The standing of every collection is based on the number of real rarities it contains.

The question of rarity seems to be of general interest. I am frequently asked to name our rarest bird—almost as often as I am to name the most valuable. First, it is necessary to establish exactly what rarity means to us. Many

birds, common enough in their native habitats, are unknown in captivity, usually because these habitats are inaccessible or because their food habits make them difficult to keep alive. Some of these may be found in series in any museum, though not at all in any collection of living birds.

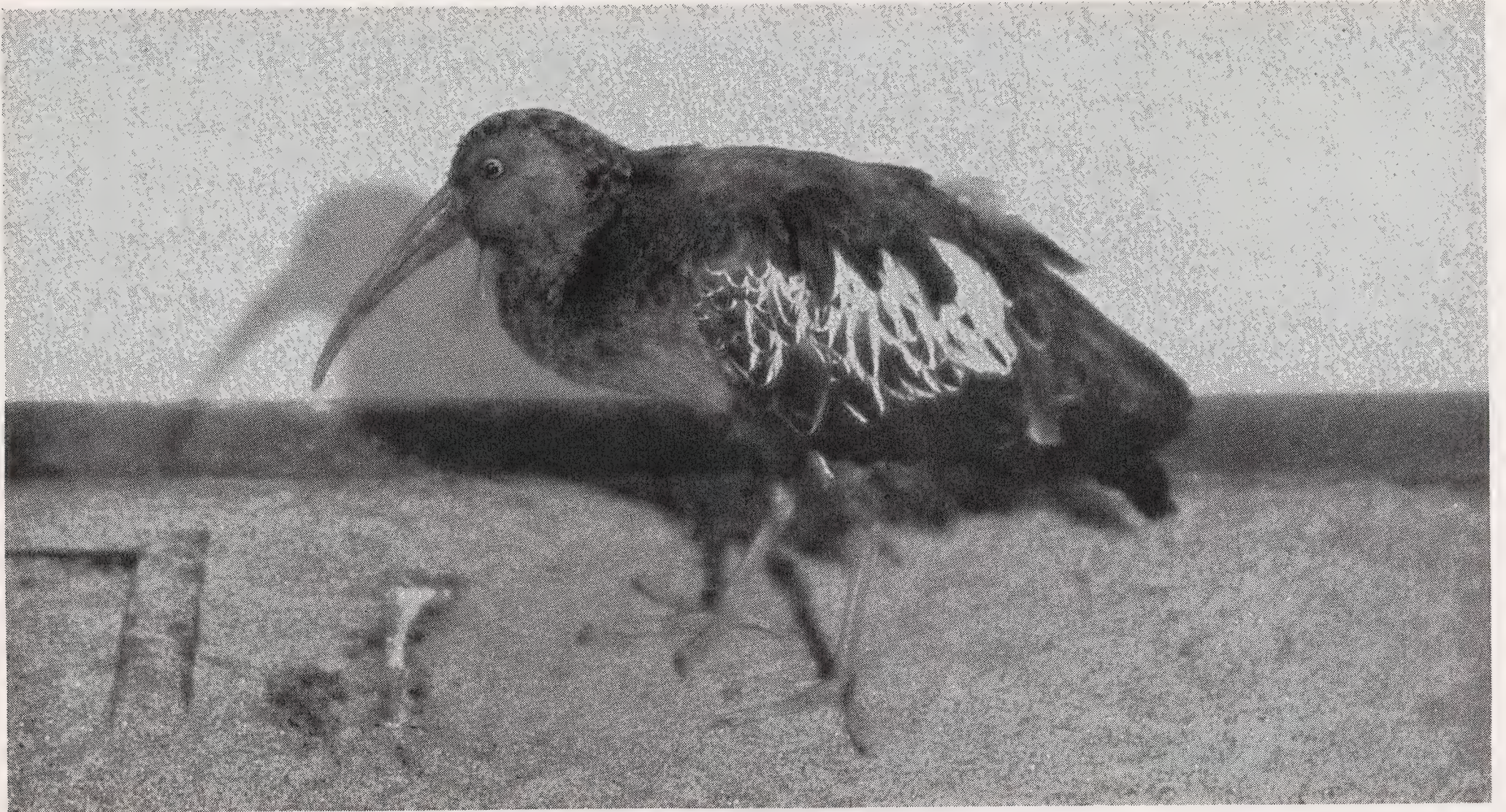
On the other hand, it frequently happens that, for one reason or another, birds not considered really uncommon in captivity are scarce in museum material. It is evident, then, that the term “rarity,” as used in aviculture, has a restricted sense. It means rare in captivity, not necessarily with relation to its state in nature or to its availability in museums.

Under this definition there are many rare birds in the Zoological Park. In *Parks and Recreation* for July, 1935, in an article called “Rare Zoo Animals,” Roger Conant lists 79 of our species as outstanding. All of them cannot be mentioned here, but we have chosen a few that seemed to us to be the most unusual. These selections have been purely arbitrary and no doubt several groups of equal value could be formed. Our birds of paradise include many real rarities, but since they were described in the BULLETIN for September-October, 1935, they have been omitted here.

Every creature living in zoological parks has a captivity history and often it is a romantic one. For the more common species, which usually arrive in numbers, this is seldom known, but



"Jimmy," the shoebill stork, is a double rarity, for he is uncommon both in captivity and in his native Africa.



The first wattled ibises ever seen alive in the United States came to the Zoological Park in 1934 as unheralded prizes in a miscellaneous lot of birds from Abyssinia. Their position as rarities is likely to remain unchallenged for a long time.

prizes are likely to reach us only after long and strenuous efforts on the part of someone, and then there may be a story worth telling.

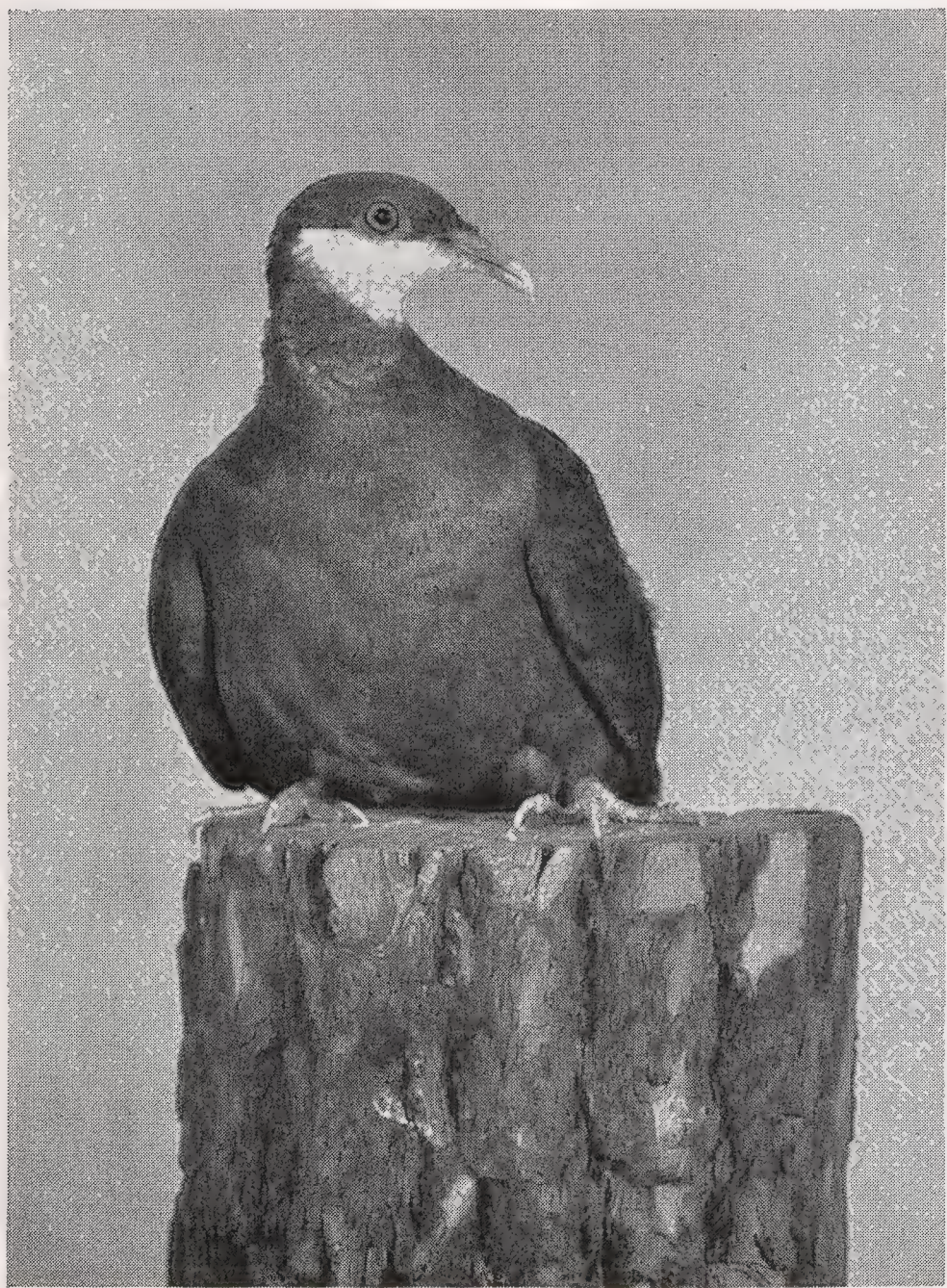
Our shoebill, for instance. "Jimmy" reached us in October, 1926, and has become so familiar to all of us that we are in danger of taking him for granted. Yet he is one of the real rarities in captivity, and has the added distinction of being far from common either in Africa or in the world's museums. Up to the time of his arrival here no living shoebill had ever been seen in America. In fact, it is doubtful if the bird had been kept at all outside the zoological gardens at Ghiza, Egypt, apart from the occasional specimens sent to the Zoological Gardens in London. Since Jimmy's arrival, several shoebills have been imported by permission of the Sudanese game authorities. Most of these birds have now passed on, but Jimmy remains as a patriarch of his species, at least in America.

Originally ordered through Ellis Joseph, the New York dealer, the commission was passed to the late George Bistany, an Egyptian who afterward became director of the Fleischacker Zoo in San Francisco. Bistany arranged with a missionary who occupied a remote post in the Sudanese swamps to secure the bird. Jimmy,

a scrawny fledgling, was taken from the nest by the mission boys and quickly developed a voracious appetite for small fish. It was not long before he was ready for the long journey to New York, but then financial difficulties about the necessary permit developed. Cable messages flashed to and fro between New York and Alexandria. Responsibility for the considerable expenditure involved could not be fixed. A year and a half, freely punctuated by frantic messages from the unfortunate missionary, passed before the question was finally settled and the permit issued. Jimmy, now fully grown, was entrusted to the captain of a slow but direct steamer for New York, and arrived here in as fine fettle as any of the first class passengers. But the minnows of a far district in the deep Sudan are probably still far below their normal numbers!

While it is true that great rarities usually are obtained only as the result of special effort, they sometimes appear, usually unrecognized, in ordinary dealers' consignments. This is most likely to happen when entirely new countries are opened, or when older ones (from the dealers' viewpoint) are more deeply worked. Some ten or fifteen years ago Abyssinia became one of

the few sections of Africa where legal restrictions did not hamper the collector. When this condition was fully realized, the gathering of specimens assumed a considerable scale and since previous shipments had been few, almost everything secured was of special interest. The natural course of business soon took care of this, however, and it became necessary to go farther afield. Perhaps it was not too surprising, therefore, when a cursory examination of a shipment of the usual Abyssinian birds arriving in New York in 1934 revealed a pair of ibises, very dirty but obviously dark in color. I was puzzled as to the birds' identity, but closer examination showed a thin, fleshy wattle pendant from their throats. They were wattled ibises, certainly the first that had ever seen our shores. Ibises are always desirable birds for us, since they are grotesque in appearance and usually live for long periods, but an entirely new ibis, one we had never seen before, was a sensation. It seems probable that this bird's claim to a



A lovely white-throated pigeon was the first bird obtained by the Society's New Guinea expedition in 1928.



The Andean goose is an inhabitant of the great mountain ranges of the western part of South America.

position in any list of rarities will remain unchallenged for some time to come.

In 1912 a visit to the old zoological gardens of Hamburg found them to be in very reduced circumstances, quite possibly because of the proximity of the great installation of the Hagenbecks at Stellingen. There were almost no exhibits of interest, but the day was not entirely lost, for I came away with a vivid impression of three lovely, white, black-winged geese grazing on a thick green lawn. This picture of the Andean goose, inhabitant of the great mountain ranges of western South America, remains fresh to this day. They were the first I had ever seen and up to June, 1935, I never saw another. On that date a fine young gander was offered in New York and was quickly added to our collection. There are six recognized forms of upland geese, all handsomely colored, but none excels the Andean.



All of the fruit pigeons are gaudily colored but none is more handsome than the golden-headed.

The birds of paradise secured by the Society's expedition to New Guinea have so far overshadowed the other specimens collected on that trip that many fine things have never received the attention they deserve. Among them is a white-throated pigeon, one of the largest and most brilliantly colored of this group. Our bird is a female which frequently lays futile white eggs, and her efforts are probably doomed to result only in frustration, for there is little hope that a mate ever will be obtained. This lovely pigeon was the first living bird obtained by the expedition, having been brought in by a native lad soon after our arrival in the mountains of central New Guinea. Like many birds of the higher altitudes, this pigeon showed little fear and quickly learned to eat her scanty rations of rice or diced banana from our hands. Her condition and the brilliance of her iridescent plumage remain as perfect after nearly seven

years as on the day she was brought into our mountain camp.

At the same point we obtained the beautiful golden-headed fruit pigeon, a pair of which we still possess. The fruit pigeons are noted for their gaudy coloration. The numerous species present every conceivable arrangement of greens, reds and yellows, but none is handsomer than the golden-headed, with green body, golden yellow head and yellow-brown breast. And few are more rare, for the species appears to have no previous captivity record.

The hornbills are a group constantly sought by zoological collectors. No species is undesirable and no species is so common that it is regularly passed by when offered. On the other hand, many large, decorated and interesting forms are difficult or impossible to obtain. Most are birds of the deepest jungle and if it were not for the males' curious habit of sealing their mates in the hollow tree nests in the breeding season, they would reach the civilized world even less often than they do. For this strange practice is often the bird's undoing. Keen-eyed natives locate the nest in trees and remove the imprisoned mother and her offspring at the proper moment. Occasionally, however, fully adult males are taken. In this category belongs our silvery-cheeked hornbill, a member of a species so rare that no other representative has ever reached us. This bird, well known to our many habitual visitors because of his typically raucous voice, was brought from Kenya Colony, Africa, by Mr. Kenyon V. Painter of Cleveland. Mr. Painter is always a keen seeker after rarities for his extensive aviaries in Cleveland and he found sufficient spare time during an elephant hunt to secure what seemed to him a most desirable addition to his collection. On his return from Africa, he spoke of his new hornbill with enthusiasm, hugely enjoying our obvious greed. We were naturally surprised when, a few weeks later, a large case arrived by express, containing a lusty silvery-cheeked hornbill. Our pleasure was tempered with curiosity—how could its owner ever have brought himself to part with such a treasure?

We had not long to wait for the answer: this hornbill was possessed of a demoniacal temper which quickly won the respect of the most experienced keepers and his voice was a devastating roar, well-calculated to startle the most blasé

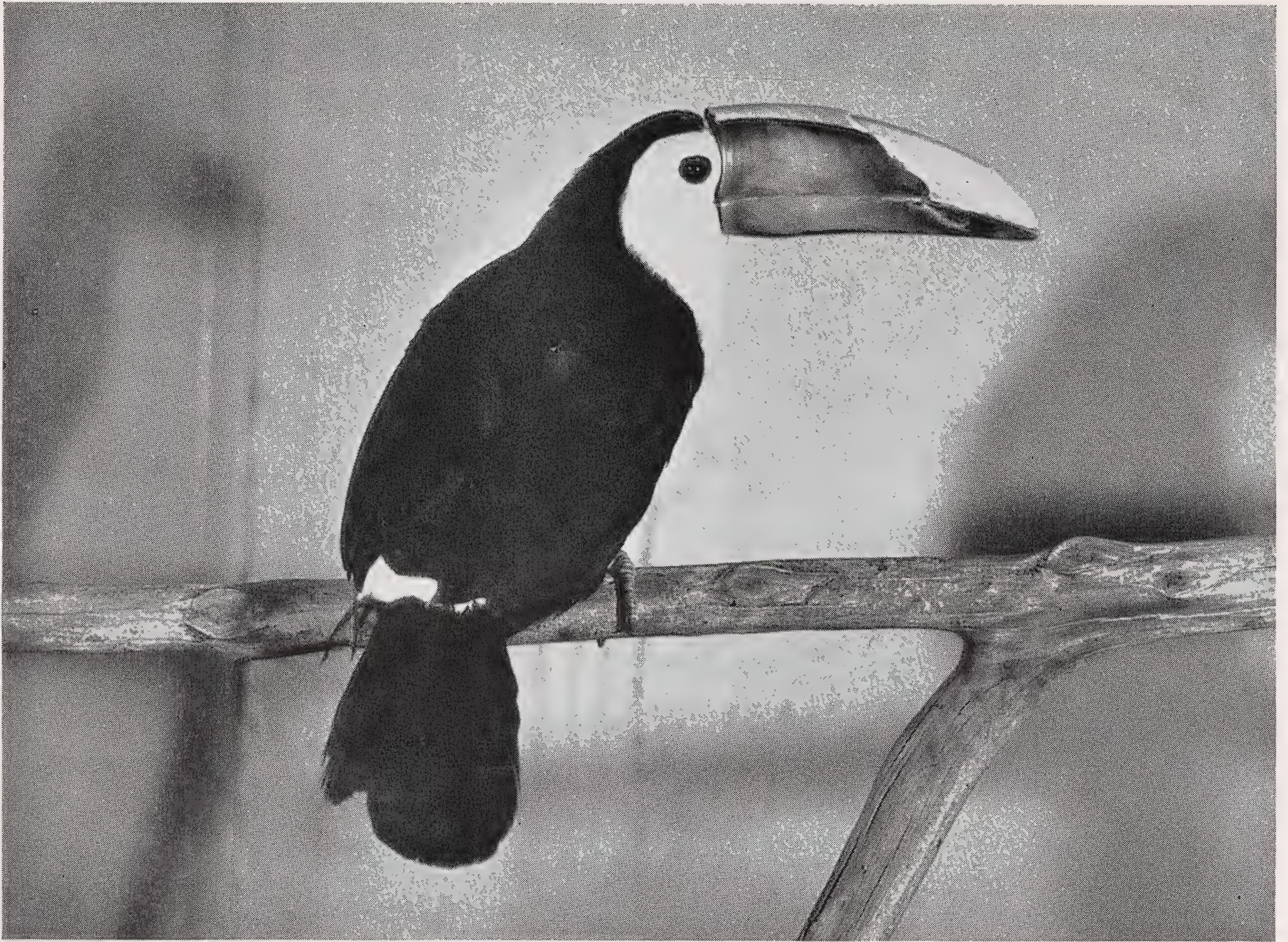
visitor. A quiet aviary in Cleveland must have benefited greatly by his departure.

Everyone knows what a toucan is—a medium-sized, blackish bird with a long bill, generally brightly colored. But everyone does not know what a Swainson toucan is. I was not quite certain myself up to a summer-like day in April, 1926. On that day I received a telephone call from an indignant gentleman who said his wife had just returned from a cruise along the western coast of South America, that she had brought with her a particularly unpleasant bird known as a toucan, that he wished to be relieved of it,

and would we accept it if he sent it up at once? Many calls of this sort come in. Sometimes we say "Yes," and sometimes "No." It is just a matter of routine. Only this time I said "Yes," and the result was not routine at all. The messenger arrived much sooner than I had expected, bearing a large cardboard carton punched with airholes. Slowly I opened the box, expecting to find a sulphur-breast, or possibly one of the little aracarís. But instead, out popped a magnificent bird, tame as a kitten, his black plumage shining like satin. His great beak was slashed across diagonally with solid

The extremely rare silver-cheeked hornbill was a gift to the Zoological Park and the reason why his owner parted with him was soon learned. He has a violent temper and his voice is a "devastating roar."





When an irritated gentleman telephoned that he had an unpleasant bird with a big bill that he wanted to give to the Park, Curator Crandall sent for it—and it turned out to be a Swainson's toucan, the first ever exhibited here.

blotches of color, red at the base and yellow at the tip. I was nonplussed; the species was new to me. But a quick dip into the library fixed it as a Swainson's toucan, known only from southern Honduras to western Ecuador.

Not two weeks after this shock, in the midst of many routine calls, another came that proved not to be routine. This was from another gentleman, the captain of a steamer which stopped regularly along the west coast of South America. He said that in one of his ports a small girl who had taken a fancy to him had insisted on giving him her pet toucan, that he had had to take it to please her, that he really didn't want it, and would we call for it? Ordinarily we don't like to send for unknown donations, especially when they are aboard ships lying at distant and inaccessible docks. As I wavered mentally, I thought of the Swainson's, and then of the saying that lightning never strikes twice

in the same place. But finally I decided to risk it and agreed to send.

Our messenger was gone most of the day, but when he returned I was very glad I had decided in favor of the toucan, for here was another Swainson's! It was just as fine as the first one, but slightly smaller, and apparently a female. Toucans are not easy to sex, since male and female are alike in color, but differences in size of body and beak give them away, and when the two birds were placed together their evident pleasure showed our surmise to have been correct. A true pair of Swainson's toucans, probably the first ever seen in any collection! The years that have passed since 1926, have failed to produce another.

At least, they have failed to produce another Swainson's, but there are other toucans just as rare and one of them came to us in almost as strange a way. Commander George M. Dyott,



An Indian chief in the jungles of Ecuador gave this lesser Wagler's toucan to Commander George M. Dyott as a valuable present, and it came to the Park eventually because its owner lacked the proper quarters for keeping it in wintertime.

the explorer, had been working in the interior of Ecuador, and there had earned the gratitude of an Indian chief. A present was in order and the chief did not have much to give, but he did have a pet toucan which was his greatest treasure. A tame bird in the middle of a jungle teeming with birds may not seem a great thing, but anyone who has tried to buy such a bird from a South American Indian will know that it is next to impossible. I have never succeeded myself; no inducement that occurred to me has ever brought the desired creature into my possession. So the chief gave the white man his bird; it was the finest gift he could bestow.

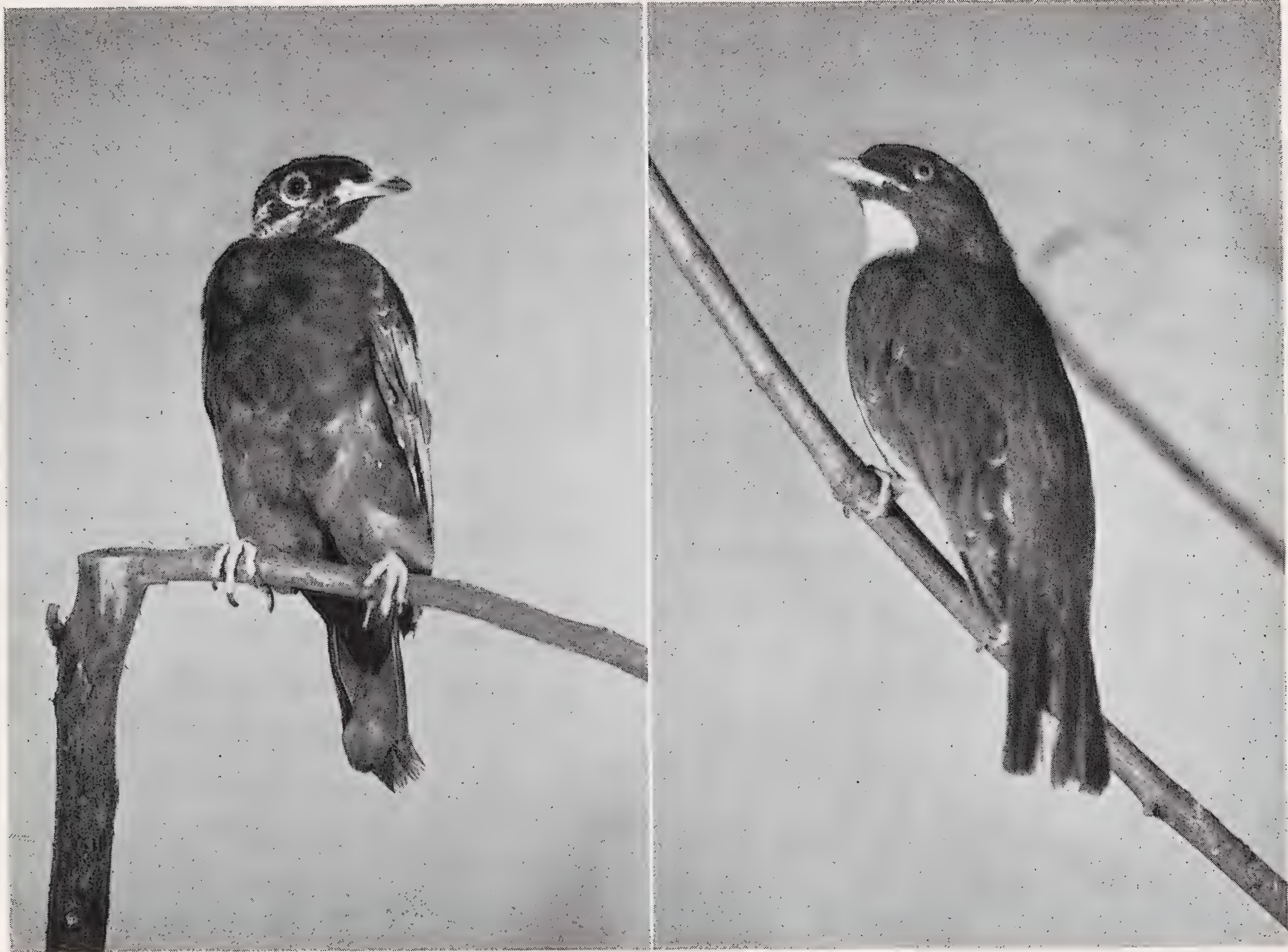
Unlike the owners of the two Swainson's, Commander Dyott liked his toucan. In fact, he liked it so much that he brought it home and kept it in the country during the summer. But when the question of winter quarters came up the only solution was the Zoological Park. So

followed the usual question and the rather less usual "Yes," this time somewhat influenced by the fact that Commander Dyott is a man who gets about. If we didn't really want the toucan, we might want very much the acquisitions of some future expedition.

But here routine was off its stride a second time, for when this bird finally appeared we were stumped again. Another new toucan!

Considerably smaller than the Swainson's, its beak was similarly marked, except that the base was black. Another hurried resort to books identified it as the lesser Wagler's toucan, found from Panama to Ecuador. And so we acquired two additions to our fine series of toucans, which still remain as the greatest rarities among them.

In South America lives a family of birds known as the cotingas (Cotingidae). They range in size from tiny things no larger than



(Left) This bare-necked cotinga was listed as a "fruit crow" when Curator Crandall found it in a shipment of birds from Germany. (Right) Within a year of each other, a female and a male golden-breasted cotinga arrived. This is the male.

sparrows to great creatures as large as crows, but this variation is not as striking as that in color and structure. While some of the cotingas are of so dull a hue that they might pass for vireos or flycatchers, others present brilliant pigments in such wide range and weird combination that probably no other group can equal them. Then, in addition, there are bare heads, naked throats, wattles, caruncles and crests in endless array. To all these attractions the cotingas add extreme shyness and in many cases the habit of haunting the tree tops which, in the South American jungles, are very high indeed. So that while a strange or raucous voice or a glint of color from flashing wings may betray the presence of one of these birds, it is seldom that a full view may be had.

Naturally, the cotingas are most desirable birds from the collector's viewpoint. Native skin hunters specialize in them and the museums

are never short of specimens. But living birds are different, for they keep too high to be caught by ordinary means. Young are sometimes taken from the nest and reared by Indian women, who have no equals in this art, whereupon arises the old problem of getting them to part with their treasures. So the cotingas remain among the great rarities in living collections. Only two—the lovely cock of the rock and the bare-throated bellbird—are obtainable with any frequency, and these may hardly be called common.

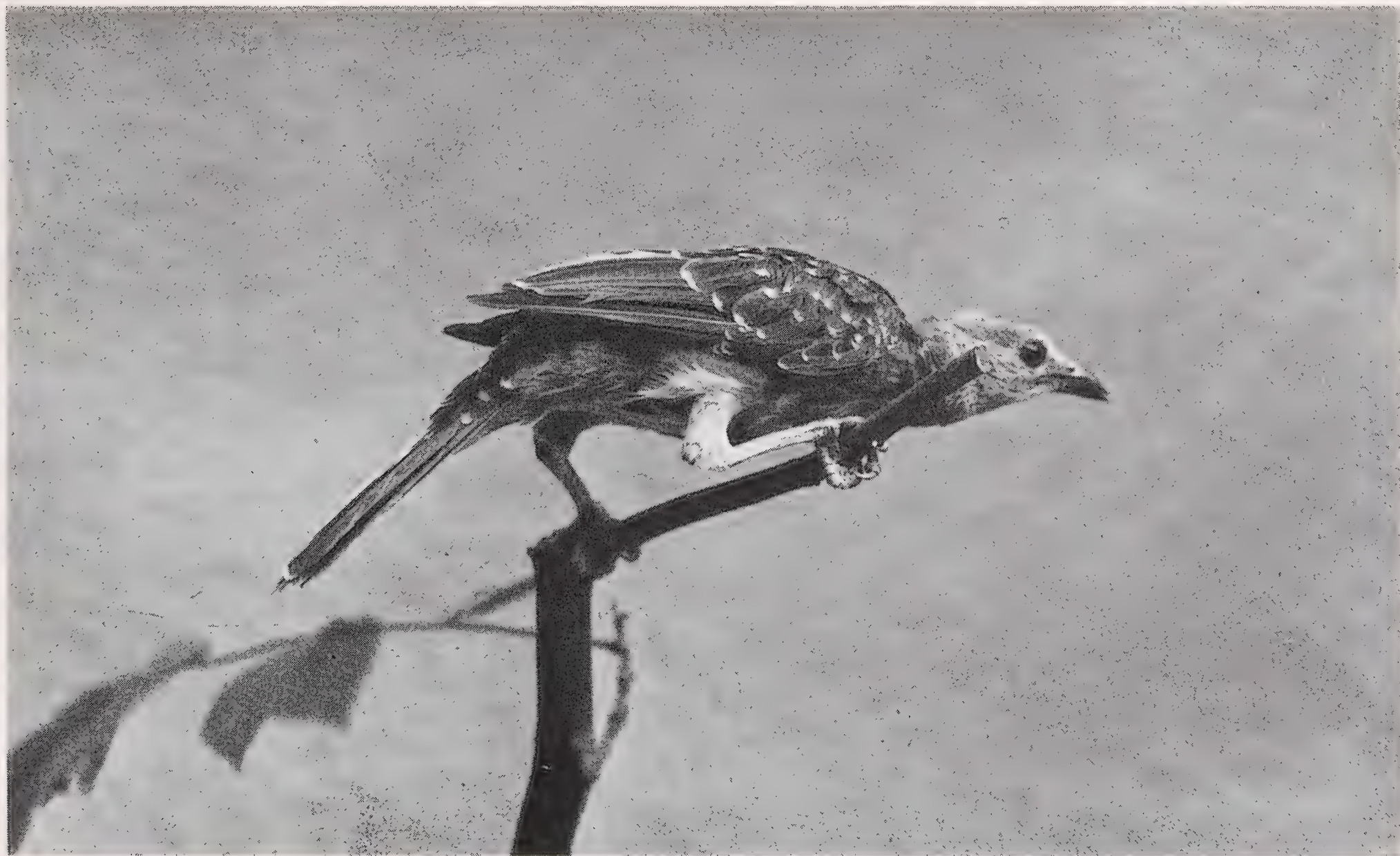
But chance has given us, and all at one time, three of the very finest species. Five years ago, while looking through a shipment of tanagers from Venezuela, I found a dumpy green bird, slightly smaller than a robin and with an orange bill, which I recognized as the female of the golden-breasted cotinga. She was a great prize, of course, but why couldn't she have been a

male? But it turned out to be just as well, for just a year later, under almost exactly the same circumstances, we discovered a beautiful male, bright grass-green with golden breast and orange feet and bill. These birds had been picked up in a South American port by a native dealer with an odd lot of tanagers and had not been seen by anyone who would recognize them, before they reached New York. That is one reason why shipments of this sort always want going through with care; one never knows what may be hidden beneath the soiled coats of the travelers. We did not know exactly what the requirements of these birds might be, since there was no record of their kind ever having been in captivity before. However, they responded at once to our experimental proffers and have never been anything but perfect since their first molt with us renewed their somewhat ragged plumage.

During 1935, two species were added to our growing list of cotingas. In June, a regular dealers' consignment from Germany contained a bird known broadly as a "fruit crow." If the exact name was unknown, the value had been

thoroughly well worked out! This proved to be a bare-necked cotinga, as large as a good-sized pigeon, generally sooty gray in color, with a fluted ruff of bare blue skin around the neck. Surely no one had ever seen this beauty alive and at close range before. But hardly a month had passed before another arrived from the same source. This, also, was added to our collection, the two birds proving to be a pair. That specimens of such rarity should arrive within this short period aroused our curiosity. How could it be that they had been allowed to leave Germany? The solution was furnished by Dr. Erwin Stresemann of the Berlin Museum, who on a recent visit informed us that the birds had come in from Pernambuco and that the Berlin Zoological Gardens had purchased the single specimen it could accommodate, leaving the others to come to America.

Later in the summer a professional collector arrived from Brazil with a large consignment of birds. Most of them were taken over by local dealers, but eventually the collector came to the Park to see what could be done about three smallish, drab-colored birds which he had



The fawn-breasted bower bird was another of the trophies of the New Guinea expedition. It started to build a bower, or play-house, last season and it is hoped that this year the bird will actually complete its construction program.

been unable to dispose of at a price that seemed fair to him. This was rather strange, for such shipments usually change hands "all or nothing." The birds must have seemed very undesirable indeed to have been rejected. It appeared that they had been brought down to Pará from the upper reaches of the Amazon where they had been hand-reared by Indians. Something in the story made us think of cotingas and an agreement was made whereby the birds were brought to us for inspection. On arrival the reason for their rejection was plain. They were three very young birds, barely old enough to eat by themselves. In color they were dull gray, slightly soiled, with white-edged wings. But there was no doubt that they were cotingas—pompadour cotingas—and some day the plumage of the males will be a deep blood-maroon and their wings will be snow white. More than twenty-five years ago, deep in the jungles of British Guiana, I caught the flash of wine and white against the green of the distant tree tops. Never yet have I seen it closer—at least, not in the living bird—but now I think that very soon I shall.

And now we come to the end of our chosen list of rarities, with another of the New Guinea expedition's trophies. This is the fawn-breasted

bower-bird, a member of the family of bower-birds (Ptilinorhynchidae) if this group is to be kept separate from the birds of paradise (Paradisaeidae). The fawn-breasted is not a brightly colored bird—it is clothed in a combination of soft brown and warm tan—but what it lacks in color it makes up in interest. Its playhouse, or bower, described in the BULLETIN for November-December, 1929, is one of the most remarkable examples known of avian constructive ability. Unlike our old satin bower-bird, which used to build almost perfect structures for all to see, our fawn-breast has never completed a play-house with us. However, during the summer of 1935 he made a very good beginning and we hope that another season will find his plans more advanced.¹

¹ The following is a list of the birds mentioned in this article:

Shoebill, *Balaeniceps rex* Gould
 Wattled Ibis, *Bostrychia carunculata* (Rüppell)
 Andean Goose, *Chloephaga melanoptera* (Eyton)
 White-throated Pigeon, *Columba vitiensis halmakeira* (Bonaparte)
 Golden-headed Fruit Pigeon, *Sylphitreron ornatus gestroi* (Salvadori & D'Albertis)
 Silvery-cheeked Hornbill, *Bycanistes cristatus* (Rüppell)
 Swainson's Toucan, *Ramphastos swainsonii* Gould
 Lesser Wagler's Toucan, *Ramphastos ambiguus abbreviatus* (Cabanis)
 Golden-breasted Cotinga, *Euchlornis aureopectus aureopectus* (Lafresnaye)
 Bare-necked Cotinga, *Gymnoderus foetidus* (Linnaeus)
 Pompadour Cotinga, *Xipholena punicea* (Pallas)
 Fawn-breasted Bower-bird, *Chlamydera cerviniventris* Gould



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Index for 1935

A Title Page, List of Contents and Index to the BULLETIN for 1935 is in preparation and will be mailed on request to any members of the Society. Indexes for many earlier volumes are still available and may be obtained on request, as long as they last.

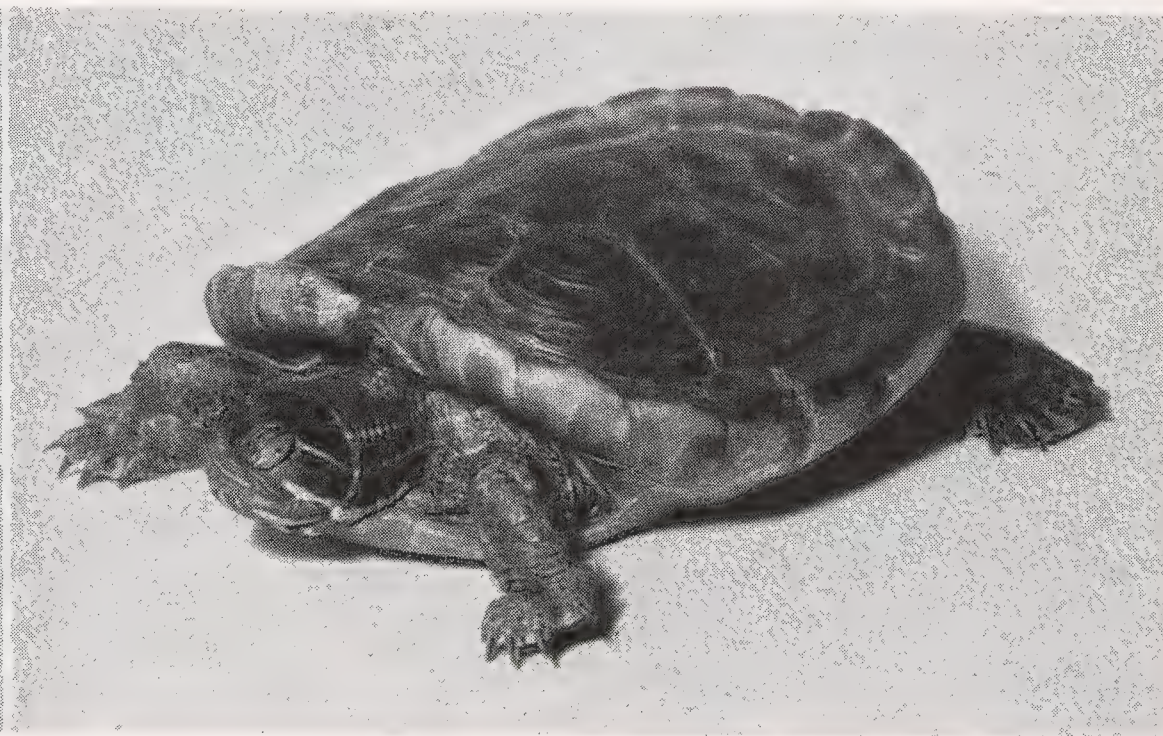
Cruelty to Baby Turtles

The American Society for the Prevention of Cruelty to Animals has requested the opinion

of the Aquarium as to whether painting the shell of a young turtle causes discomfort or retards its growth. The chief clerk of the A.S.P.C.A. quoted substantially as follows from a letter sent to it: "We are concerned over the plight of a tiny turtle sent us from Florida. It has a gorgeous scene painted on its back. As time passed it grew but the shell remained the same size. It is now impossible for it to draw in its head, legs and tail under its protective covering and it looks most uncomfortable."

The Aquarium had received some baby turtles in a similar fix and replied as follows: "We are pleased that you are considering the matter of the painting of baby turtles. I saw recently in Miami, Florida, considerable numbers of baby turtles painted in fantastic colors. It can do them no good and with the harder kinds of paints, interferes with their growth. We had here, at one time, a baby tortoise, I think from Egypt, the shell of which was covered with mosaic designs, the bits of stones being firmly cemented to the shell. Young turtles are interesting enough to most people in their natural condition. Painting them can only cause discomfort and in some cases interferes with their growth."

Mr. Coates, of the Aquarium staff, reported that when a simple paint is used, either water or oil, it will eventually crack and flake off, apparently causing the animal no distress. However, when an enamel paint or celluloid paint is used, the growth of the scute is apparently inhibited. In cases observed at the Aquarium, in



The baby turtle at the left has a typical "artistic" scene painted on its back, and the results of such misplaced theories of decoration are seen at the right where a turtle's carapace has been deformed by the unyielding nature of the paint.

which the animal had grown as little as 10 per cent., the coated carapace remained the size it was when painted, while its entire margin grew outward and curled up at the edges. The paint was cut from a number of painted turtles sent to the Aquarium and it was found that if there was little deformity in the carapace the creature would recover, but that if it had been curled up the animal invariably died, although not immediately.

C. H. T.

Water-walking Lizards

Of the various groupings of lizards, approximately about three thousand kinds, a few families are New World and several are represented only in the Old World. The most extensive New World family is the Iguanidae. Its members exhibit great variation in size and form. They range from six-foot iguanas to desert swifts but a few inches long. Some are extremely elongate while others have a squat body and short tail—the latter form represented by the horned “toads.” Their habits are arboreal, ground-running or a mixture of both. This description relates to a genus of the latter types.

Ranging from tropical Mexico to extreme northern South America is a genus of lizards made up of four known species. The form is slender, the tail forming about two-thirds the total length. The maximum length is about a yard, although the average is a third less. The males of all four species have a high crest upon the head, standing up like the comb of a rooster. One species has an additional and elongate crest on its back, standing up like the fin of a fish, and a third protuberance decorates the tail. Scientifically, these lizards are assigned to the genus *Basiliscus*. In the tropics they are commonly known as basilisks or “dragons.” They are most commonly to be seen on the ground and in the vicinity of water. They are extremely active and remarkable in almost immediately rearing and running on their hind legs when dashing away from an intruder.

My most frequent contacts with these curious lizards was in Honduras and I noted them to be most abundant in the neighborhood of the Ticamaya Lagoon, an extensive inland swamp. When surprised along the margin of the water-

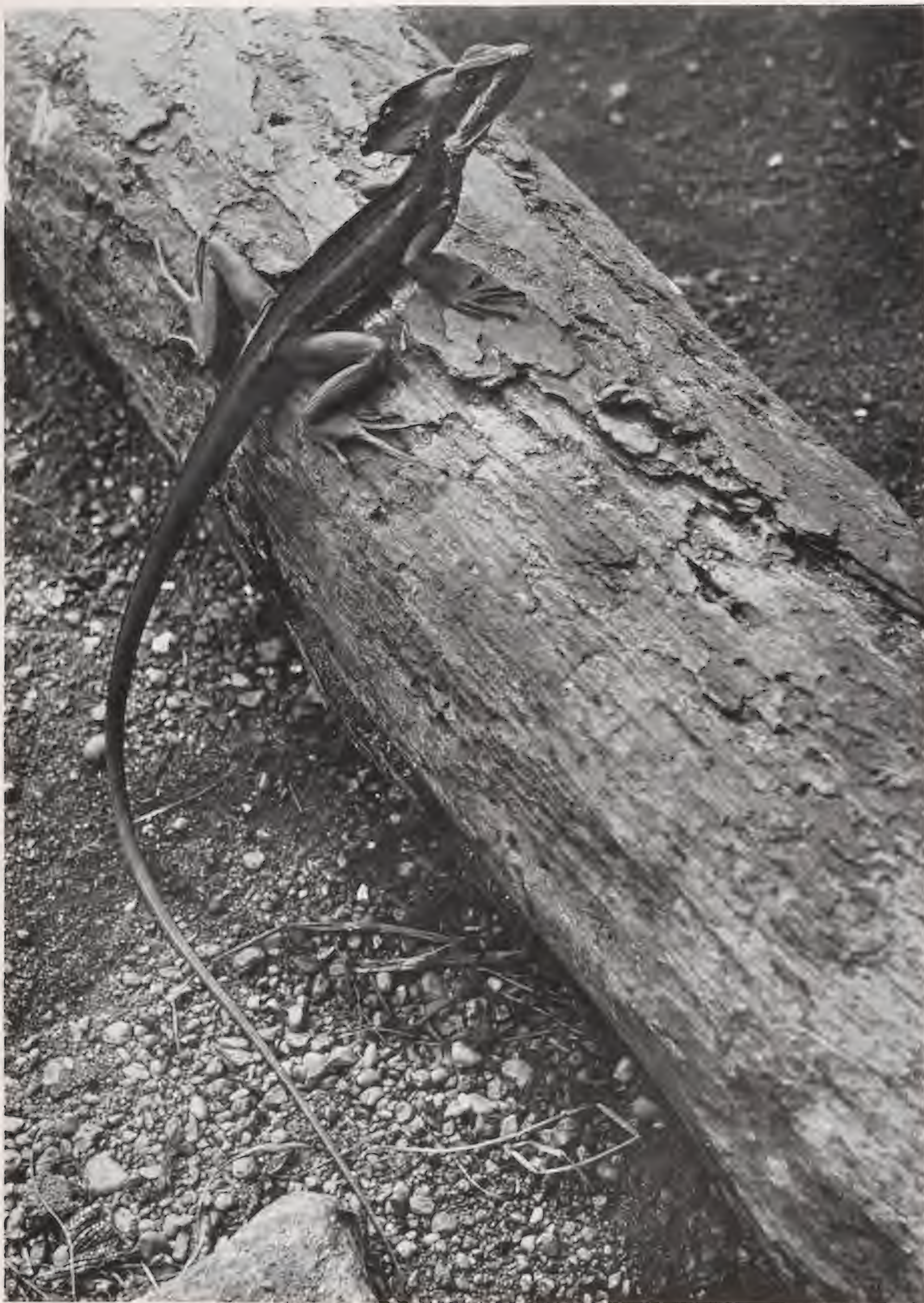
way a lizard would dash in upright position down the gently sloping bank and rush out over the surface of the water, over which it would scamper without sinking, leaving a wake like the elongated backbone of a fish. The rush would lead to a protruding stump upon which it would climb and cling. My only explanation of the reptile's ability to run over the surface was the speed gathered in the preliminary rush from the shore—like throwing a flat stone or “scaler” from the shore. As there was plenty of derelict timber in the lagoon, the lizards seen there almost invariably ran for such an objective. My guides very seriously referred to this species as the Jesus lizard, because it walked upon the surface of the water. The species was *Basiliscus vittatus*, which ranges from Mexico to Ecuador.

Later, in Panama, I had an opportunity of observing the habits of the larger “plumed” species, *B. americanus*. The area was a small lagoon of black and foul water, with muddy banks. The large males, nearly a yard in length, would rush down the bank in erect position and despite their fair body weight traverse fully twenty feet of water to the opposite shore.

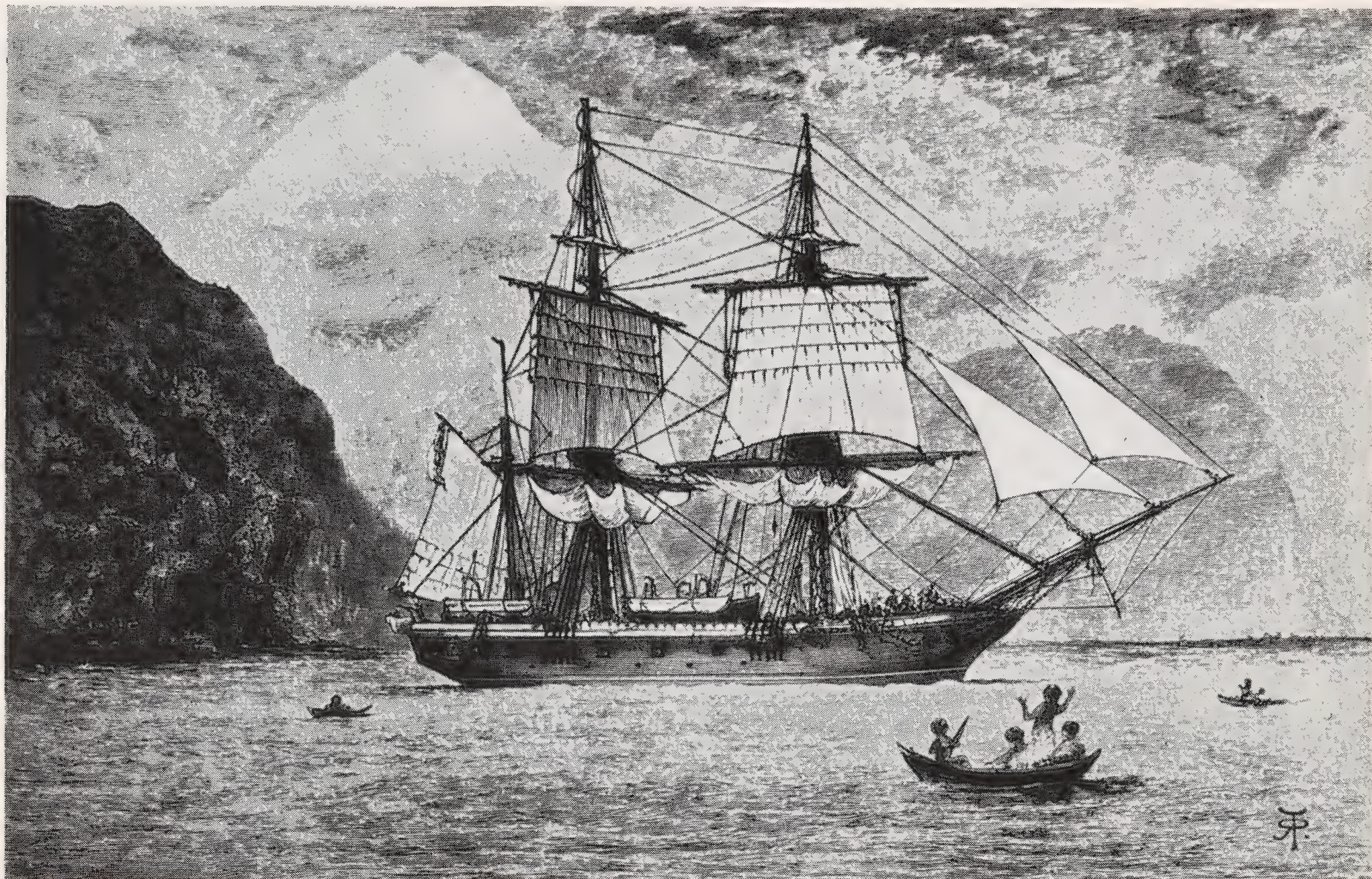
If disturbed while in low trees overhanging the water, basilisks will make a plunging dive, swim to the bottom and hide. Most commonly, however, the attention of the observer is attracted to their dashing about in erect position.

While the species of *Basiliscus* are particularly spectacular in their erect running and ability to cross water without sinking, the habit of dashing away on the hind legs exists among a number of species of the Iguanidae. It is to be noted with the collared lizards, *Crataphytus*, of the southwestern United States and the habit is occasionally assumed by the big iguanas. Nor is this trait limited to species of a single family, or to New World lizards. Several of the Australian lizards of the family Agamidae dash away in just this fashion, running long distances with the body quite erect. To refer such manifestations to the erect-running dinosaurs would be mere supposition. It is strange, however, that four-legged types, capable of swift movement upon two equally well-formed pairs of limbs, should display such tendencies.

R. L. D.



Note the comparatively heavy muscular development of the hind legs of this banded basilisk—one secret of its amazing speed in an upright position. The large head-crest shows that this specimen is a male.



From "The Voyage of the Beagle," Courtesy New York Times

H.M.S. Beagle in the Straits of Magellan.

Salute to Capt. Fitzroy

During the past year many scientific associations in Europe and America have celebrated in some way the centenary of Charles Darwin's five-year voyage around the world in the *Beagle*. It is not of Darwin's work on that epoch-marking voyage that I write here, but of the ship that he made famous—*H.M.S. Beagle*.

The ship was under the command of Captain Fitzroy, R.N., whose instructions included, among others, making a survey of the Straits of Magellan and parts of Tierra del Fuego. About two years of the voyage were devoted to this work.

It was my fortune, forty-eight years ago, to spend two months in those far away waters, during the investigations of the U. S. Fisheries' steamship *Albatross*. Navigation through 400 miles of the Straits is not a simple matter, even for a full-powered twin-screw steamer. I had with me Darwin's "Voyage" and soon acquired a high respect for the seamanship of Captain Fitzroy. There are channels with dangerous tides that must be negotiated at slack water. That Fitzroy did his long survey work in a *sailing vessel* impressed me.

No mishap befell the *Beagle*. The old picture shown here is more than a mere drawing of a sailing vessel. There was behind the artist a master mariner, who made the picture show just what the *Beagle* was about at that particular moment. She is not anchored, but "laying-by," as sailors would say. She is near the South American mainland and headed to the westward. Beyond is Tierra del Fuego with Mt. Sarmiento's 7,000 feet of ice showing clearly. There is little wind; the Fuegian canoes are in smooth water. Jibs, fore-topsail and spanker are hauled close and the barque would drift ahead had not the main-topsail been hauled aback. The two top-gallant sails are furled—no use for them with quick work ahead. Foresail and mainsail are clewed up. Most likely she is ready for the next channel. At slack water the braces will be hauled and the main-topsail set like the fore-topsail; the clewlines will be slacked and foresail and mainsail set. Close hauled, the *Beagle* will move in the direction in which she is headed.

Much has been said about Darwin and the *Beagle*. This is a salute, only one hundred years late, to Captain Fitzroy for Admirable Seamanship.
C. H. T.

PUBLICATIONS

Free to Members:

Bulletin: The official publication of the New York Zoological Society reports bi-monthly on interesting phases of work at the Park and the Aquarium and contains articles on natural history in a sound yet popular form, with many illustrations. Thirty-eight volumes have been completed.

Zoologica: Scientific contributions of the New York Zoological Society. Volumes I-XIX are complete, and other volumes are in preparation. *Zoologica* is illustrated, and is published as material is presented. It is sent to Members on request.

Zoopathologica: Scientific contributions of the New York Zoological Society on the diseases of animals. Volume I and II are completed. It is illustrated, appears when material is available, and is sent to Members on request.

Annual Report: Documents, reports and pictures of the work of the various departments of the Park and the Aquarium. As a rule it contains articles of scientific value and considerable general interest.

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.....: PETS AND HOW TO CARE FOR THEM. 296 pages, 96 illustrations. 1930. \$2.

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A valuable classification and reference book for schools and students of zoology.

All these books and others by the same authors may be obtained from the New York Zoological Park. For book express add 15 cents postage for each volume.

A classified list of the publications of the Society, with subject headings of articles printed in the *Report*, *Zoologica* and *Zoopathologica*, as well as reprints from them, will be furnished on request. Some of the publications have become exhausted and orders for any issues will be governed by this circumstance. Orders for any of the publications should be addressed to H. R. MITCHELL, *Manager, Zoological Park*, 185th street and Southern Boulevard, New York City.

No effort will be spared to ensure delivery of the regular publications to Members of the Society, but changes of address, forwarding points and non-delivery of mail should be reported promptly. Back numbers of *Bulletin* still in print will be supplied to Members and others at the rate of 30 cents each. Postage 3 cents extra.

Clark and Fritts, New York, Printers.



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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

Annual Membership in the Society is \$10, renewable annually. Life Membership may be obtained for \$200. A contributor of \$1,000 becomes a Patron; \$2,500 an Associate Founder; \$5,000 a Founder; \$10,000 a Founder in Perpetuity, and \$25,000 a Benefactor.

All classes of Members are entitled to receive every periodical publication, the privileges of the Administration Building with its lounges and reception rooms and gallery of paintings of animals, to attend lectures, open meetings and entertainments, and to be admitted free to the Zoological Park and the Aquarium every day in the year.

Application for Membership may be given to the Director of the Zoological

Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 101 Park Avenue, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



Sunset on Isle Royale

BULLETIN

NEW YORK ZOOLOGICAL SOCIETY

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March-April, 1936

No. 2

Isle Royale—the Next National Park

Michigan and the Federal Government Are Working Together to Buy the Island in Lake Superior and the End Is in Sight

BEN EAST

Nature Editor, Grand Rapids Press

YOU stand on the forward deck of a boat and watch a low, blue-hazed reef climb slowly out of the wide gray plain of Lake Superior. A smart breeze comes out of the northwest, from the direction of the reef, and your boat pitches and rolls to the seas with little effort.

Minute by minute the reef climbs higher. Long ridges, individual humps begin to rear themselves against the sky. The hazy land stretches away now to northeast and southwest, running off into distance like a mainland shore.

The distance-begotten haze dissolves gradually, timber takes form on the crests and slopes of the ridges, bright green masses of birch and aspen pricked with the darker hue of spruce and fir. And finally you can see the naked rocky shoreline, flinging cliffs and headlands abruptly up from the water, with a thin line of silver at their feet where the backwash of the seas surges lazily against the rocks.

That is how you see for the first time Isle Royale, mighty Lake Superior island that is the last fortress of unspoiled, untouched wilderness in the Middle West, destined to become the next national park established in the United States if present plans are carried out.

The plan to make a national park of Isle Royale goes back many years, chiefly as a dream in the minds of a small group of outdoor-conscious Michigan people. There were major ob-

stacles in the way, however, and the plan progressed slowly. Most of the island was in the hands of private owners, an outgrowth of copper mining activities carried on there between 1843 and 1880, and the problem of land acquisition loomed large.

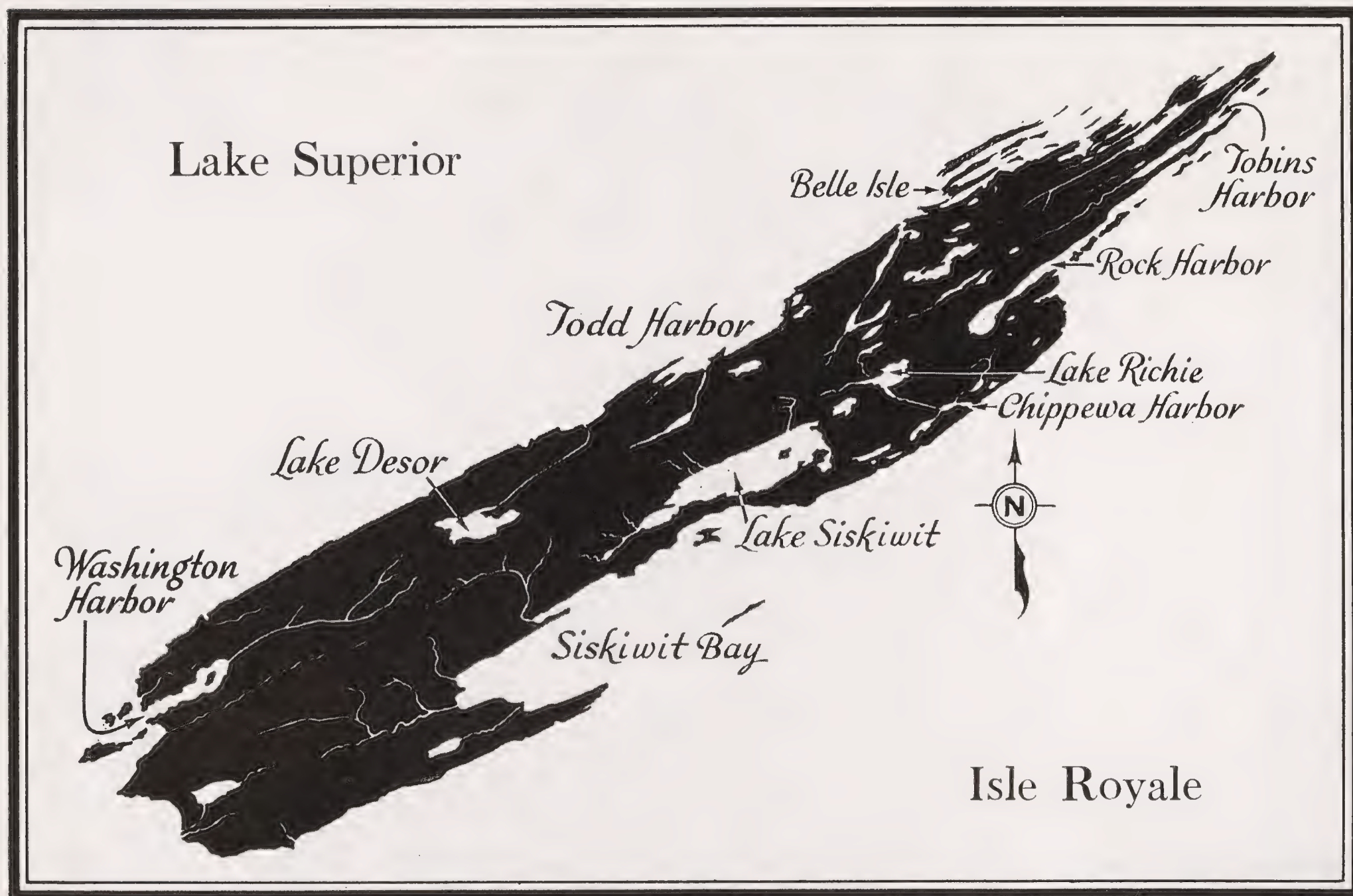
It was not until the winter of 1931 that Congress passed and President Hoover signed a bill authorizing the National Park Service to accept Isle Royale for national park purposes when the land should be acquired and ceded to the Federal government.

This action, fathered by Senator Arthur H. Vandenberg of Michigan, lent considerable impetus to the park plan for a time and resulted in the Michigan Legislature creating an Isle Royale National Park Commission in the state to undertake land acquisition.

The depression was by that time exercising its grip on the country, however, and funds for the park project could not be found. The plan bogged down and lay dormant until the spring of 1935, when word that a logging company was to begin cutting pulpwood on Isle Royale brought a sharp outcry and an urgent demand for the preservation of the island in its present unspoiled state.

Harry Harper, chairman of the Isle Royale National Park Commission, had worked tirelessly with national park officials and in the summer of 1935 their efforts bore fruit when President Roosevelt signed an order appropriating \$705,000 for the purchase of privately

The photographs accompanying this article are by the author, unless otherwise credited.



owned lands on Isle Royale, to protect government holdings already established there.

Optioning of the private lands was begun immediately and at this writing is still going forward. Once this work is completed—and the Federal government has announced its intention to own every acre of Isle Royale in fee simple if the island is to become a national park—and the options taken up, the actual creation of the park will be at hand.

In the meantime one CCC camp was established on Isle Royale late last summer and plans have been laid for the establishment of four camps on the island this coming year, in the interest of trail building, fire line clearing and similar work.

The national parks service has announced that its plans for the development of Isle Royale, once the acquisition of the island is completed, do not include motor roads or other “civilizing” influences. This great north country island is to be left, so far as is practicable, in the condition of wild and unspoiled beauty in which it has existed since long before the white man saw it.

There are at least three things of outstanding

interest about the creation of the Isle Royale park. First, it will be the only national park in the country located entirely on an island. Second, it will be the only national park north of the Ohio river between the Mississippi and the eastern seaboard. Third, it will serve to preserve forever a unique and outstanding example of the rugged Lake Superior region—one of the most fascinating in the United States—in its primitive state.

Over Isle Royale, as over much or all of the Lake Superior country, there hangs a peculiar charm and glamor. It has been wisely said that this vast lake, mightiest of the world’s fresh water seas, is the least known body of water in the United States. To those who follow its rocky shores or invade the neighboring wilderness that rings it about, it offers numerous and varied attractions.

Isle Royale itself is the top of an ancient ice-worn mountain range that lifts from the vast plain of the lake about fifty miles north and west of the Keweenaw peninsula, northernmost point on the Michigan mainland. The island is separated from the rugged Canadian shore by a channel only fourteen to twenty

miles wide, lying off Pie island at the entrance to Thunder bay.

In shape Isle Royale has been likened to a giant schooner set forever on a northeast course, with a fleet of small tugs swimming at her bows. Countless small islands make up this fleet, ranging in size from tiny bare rocks that support not a single tree but afford a resting place for the ever-present herring gulls, to Amygdaloid island, the largest, which is seven miles long.

Formed of a series of long, parallel ridges, the upturned edges of ancient lava flows, Isle Royale is forty-eight miles long and averages about five miles wide, having a maximum width of nine miles. Its total area is 205 square miles.

In the valleys between the ridges are cradled more than thirty inland lakes. The largest, Lake Siskiwit, is seven miles long. The smallest are no more than timber-fringed ponds, some of them not even indicated on maps of the island. From these lakes and from swamps that lie in other valleys the streams of Isle Royale arise.

They are small, these streams, and many of them are nameless. They take their tumbling way down the slopes of the ridges in long chains of rapids and tiny waterfalls, with deep dark pools between, and in those pools dwell speckled trout, unsophisticated and unwary. In the long narrow harbors that indent the rugged shore, running back for miles like low-walled fjords between the timbered hills, larger speckled trout, the famed coasters of Lake Superior, formerly abounded. The nets of fishermen have largely accounted for them, however. In the inland lakes are found northern pike, wall-eyes, perch and other fish.

The bird life of Isle Royale is what one might expect to find in such an area of northern wilderness, associated with the aspen and birch that cloak the ridges sparingly and the tangled spruce, balsam fir, tamarack and cedar in the swamps.

Here the bald eagle finds solitude to its liking, nesting in perhaps greater relative abundance



The herring gulls are the best fishermen that frequent Isle Royale and here they perch on a wave-washed rock at the entrance to Rock Harbor, resting from their labors. They breed in several places about the island, including a wildlife sanctuary.



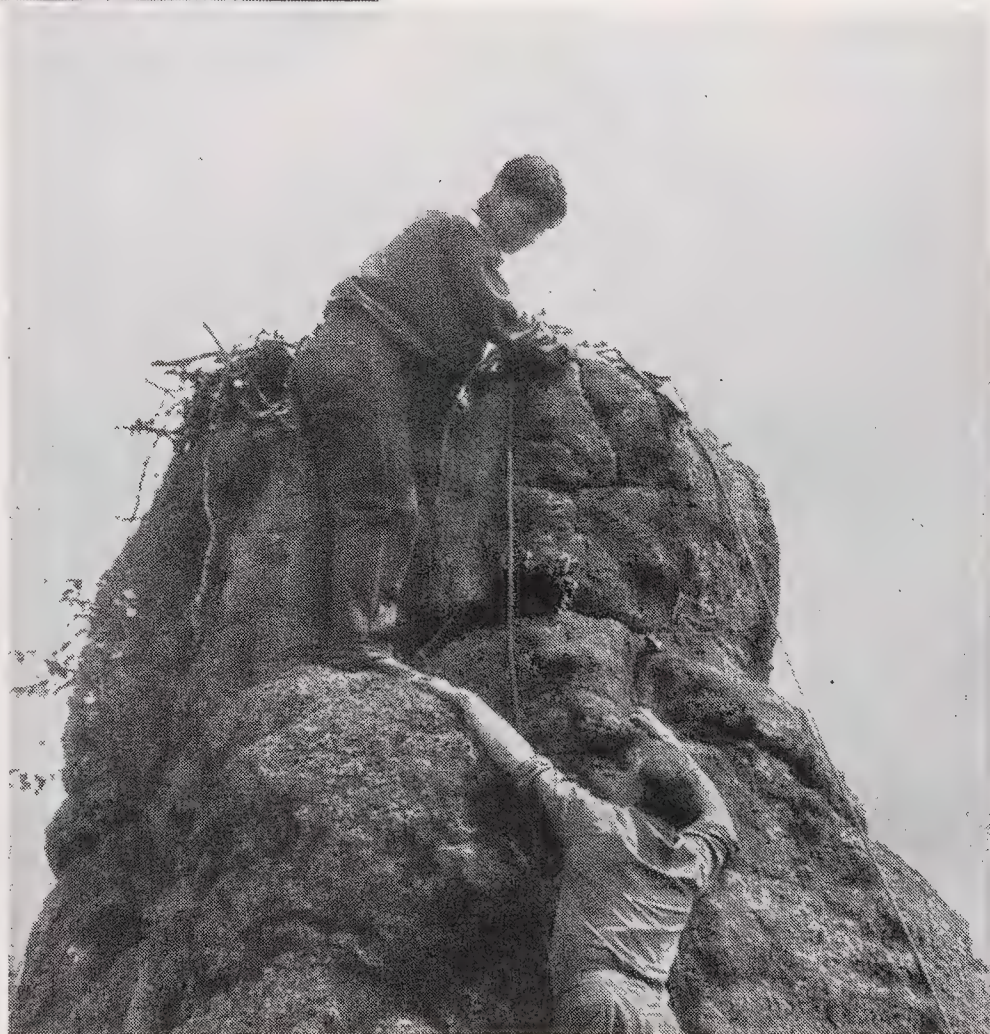
The first nesting record of the Canada jay for Michigan was established on Isle Royale last April. At the left is a Canada jay with one of its offspring. (Below). The osprey nests on a high needle of rock that is difficult of access.

than anywhere else in Michigan. Here that lesser fisherman, the osprey, likewise builds his aerie atop a suitable dead stub or a towering needle of rock.

The wilderness lakes of the interior attract loons in numbers and the weird rolling laughter of the great diver is a characteristic part of the summer nights on Isle Royale.

The northern pileated woodpecker is common throughout the island, and the northern raven, greatly reduced in numbers throughout the rest of its Michigan range, still makes its home and almost certainly nests in the deep forests of Isle Royale. Strangely enough, that other typical bird of the northern wilderness, the spruce grouse or spruce hen, is not found on Isle Royale, although present in reduced numbers along the south shore of Lake Superior. One other member of his clan, the pintail or sharptail grouse, inhabits a few places on the island, usually ranging in old burnings or other open areas.

Herring gulls are everywhere present, breeding in several places about Isle Royale. One of these breeding grounds, the Siskiwit islands, a rocky chain along the outer reef of Siskiwit bay, has long been administered as a wildlife sanctuary by the United States Biological Survey, having been so designated by President Theodore Roosevelt.



Among the smaller birds of the island perhaps the Canada jay or gray jay is most typical and interesting. A year-around resident, this hardy jay of the northern wilderness abounds in every section of Isle Royale, as plentiful and tame in the remote swamps as he is about the lonely homes of the fisherfolk.

It was my good fortune last April to establish on Isle Royale the first nesting record of the Canada jay for Michigan, when I came upon a nest with fledgling young, in a small balsam fir less than a half mile inland from the Lake Su-

perior shore at Chippewa harbor. It is interesting, I think, to note that the nest—later collected and presented to the Cranbrook Institute of Science at Bloomfield Hills, Michigan—contained large quantities of kapok, a cottony material which the Holger Johnson family, fishermen living on Chippewa harbor, had removed from discarded life preservers and used to chink the walls of their cabin. The whisky jacks had followed the best traditions of their clan by appropriating this in whatever quantity they needed. Apparently they preferred it to the gray-green "hanging moss," a lichen that festoons the dead branches of spruce and fir throughout Isle Royale, although they had used some of the latter material as well.

In addition to the birds named, Isle Royale has a host of others more commonplace, some resident and some passing through on the spring and fall flights. During the last week in April last year, when the early spring migration was approaching its peak, Walter Hastings of the Michigan Conservation Department, one of the

state's outstanding bird men, recorded forty-nine species on the island or off its shores, as follows:

Song sparrow, robin, American merganser, black-capped chickadee, black-poll warbler, palm warbler, red-breasted nuthatch, herring gull, American golden-eye, Holboell's grebe, crow, junco, raven, flicker, bald eagle, white-winged scoter, loon, oldsquaw, rough-legged hawk, northern hairy woodpecker, savannah sparrow, purple finch, pileated woodpecker, American crossbill, redpoll, ruby-crowned kinglet, bluejay, greater yellowlegs, white-throated sparrow, Canada jay, scaup, Wilson snipe, tree swallow, Cooper's hawk, great horned owl, snow bunting, golden-crowned kinglet, downy woodpecker, kingfisher, pine siskin, great blue heron, arctic three-toed woodpecker, green-wing teal, pied-billed grebe, broad-winged hawk, English sparrow, sharp-shin hawk, rusty blackbird and red-tail hawk.

When we come to the larger mammals of this future national park we are struck immediately



The beaver is far less common on Isle Royale today than it once was, having suffered heavily from trapping—largely illegal. Nevertheless a few beaver houses are still to be found along the waterways and it is possible for the animal to come back.



(Upper). There are innumerable little isles around Isle Royale, and even in its lakes. Here on Ryan Island near the east end of Lake Siskiwit the trout fishermen have pitched their tent. (Lower). The rocky shore of Isle Royale.

with several conspicuous and rather surprising gaps that break the chain of what might reasonably be expected in the way of four-footed life.

There are no deer, no black bears and no porcupines on Isle Royale at the present time. Or at least there are no records of this trio in recent years. Yet all are found on the mainland, along both the north and south shore of Lake Superior.

Perhaps even more surprising is the fact that no records are known on the island for the porcupine and bear. A small band of white-tail deer was introduced on Isle Royale shortly after 1920 by the Michigan Conservation Department, but apparently all have disappeared. At least no positive evidence of deer have been seen on the island for several years now.

Just why these animals, and especially the bear and porcupine, should be absent from an island of such size, lying so near to the adjacent mainland, presents an interesting puzzle to the student of animal distribution. There is no evidence to show that either of the latter two ever was found on Isle Royale and it appears unthinkable that either could have been exterminated by any human agency in an island never more than sparsely populated.

Of the so-called predators on Isle Royale today, the coyote by far exceeds in numbers all the others and is in fact about the only one deserving of mention.

This invader from the west has proved his fitness to exist under timberland conditions, on Isle Royale as elsewhere in northern Michigan, Wisconsin and Canada, by thriving and increasing until he dominates every section of the great island today.

In the winter of 1930-1931, with two companions, I spent eleven days on Isle Royale, flying from Grand Rapids, Michigan, by way of Duluth, Minnesota, and the north shore of Lake Superior. At that time the three of us were the only humans in all the lonely, lake-girt

wilderness of the island. Nothing lingers more keenly in my memory of that trip than the sunset and dawn chorus of coyotes. Whenever the weather was clear they set the forest about our cabin ringing with their weird howling, answering each other from ridge to ridge until the daybreak or the early evening was filled with their wild and savage song.

On one occasion while I was crossing the island alone on snowshoes a coyote howled at intervals for perhaps fifteen minutes, at mid-day, just beyond the first ridge from Chicken-bone lake where I was walking. I am sure, however, that he did not know I was there or he would have been more wary. Although, for that matter, the brush wolves are far less fearful of man on the island than on the adjoining mainland where they have been harassed relentlessly by trappers for many years. In northern Michigan a snowshoe trail is a thing of terror to a wandering coyote, to be avoided or crossed in one great leap. On Isle Royale it is no more than a beaten pathway, to be trotted in without concern if it chances to go in the right direction.

Of the coyote's larger kinsman, the gray wolf or timber wolf, I doubt whether any remains alive on Isle Royale. Probably no one can say this with certainty, but if there are gray wolves on the island, assuredly their numbers are very few. Once, before the coyote came, they were abundant.

Gone, too, is the Canada lynx, once the most prized fur bearer on the island, or so nearly gone that no lynx signs have been reported authoritatively in the last several winters.

The last heavy catch of lynx pelts seems to have been taken from Isle Royale in the winter of 1915-1916, when three trappers from the Michigan mainland wintered there in complete isolation. I have talked with Sam Bennett, one of this trio. He tells me that lynx were then abundant and the catch heavy, and he shares



Labrador Tea



Historically and numerically, moose are the outstanding mammals of Isle Royale. To them the island owes much of its prominence in the public mind, for they produced a problem in conservation that has given the authorities much to worry about.

the belief that few were left when that winter of systematic trapping was ended.

In past years the bay lynx or bobcat, smaller cousin of the Canada lynx, also was plentiful on the island. Capt. Bob Ellsworth, who made an annual cruise to Isle Royale for many summers when the island was far less known than today, in command of the Michigan Conservation Department boat, Patrol No. 1, tells me that it was a common experience, while lying at anchor deep in the harbors of the island, to hear bay lynxes wailing on the nearby ridges like overgrown tomcats.

I question whether the bobcat is entirely gone from Isle Royale today, but if not, at least he is a decided rarity.

Perhaps most important, and certainly most dramatic, of all the mammals that have passed in recent times across the stage of this great island and vanished, are the woodland caribou.

No one seems to know when the caribou first appeared on Isle Royale. Evidence as to their abundance, even, is conflicting. But there is no doubt that they were there up to less than two

decades ago, and probably in such numbers as to have constituted the largest herd of their kind in the United States east of the Rockies.

Bill Lively, a Michigan game warden who spent several winters on Isle Royale about 1920, trapping predators, frequently himself and his wife the only winter residents of the island, tells me that the caribou were generally distributed, frequenting bogs, open burnings and ridges. In any event, that is where he most frequently saw them. He has little data to offer as to their numbers, however, the most he ever saw at one time being eleven. Small bands of two, three or four were much more common, he says.

From Fred Manthey, a cottage owner who has summered on Rock Harbor near the eastern end of Isle Royale annually for more than thirty years, comes the best data on the size of the caribou herd.

Manthey believes it numbered at least three hundred to four hundred animals at its peak. While never as abundant as the moose later became, there were many caribou scattered throughout the interior of the island, he says.

What caused the disappearance of this interesting form of wildlife, no one can say. Apparently the caribou began to go when the moose came, about 1912, and their decline was rapid. As far as I can learn, the last woodland caribou seen on Isle Royale was reported in 1924 or 1925, and I feel it is safe to say the animals have been extinct on the island for at least five years or more.

In connection with their disappearance, George Shiras, III, Marquette naturalist and noted camera hunter, makes the interesting observation that throughout Canada moose and caribou will not consort on the same range. Is that the answer to the riddle of the disappearance of the woodland "reindeer"?

One other animal is far less abundant on Isle Royale today than it once was. That is the beaver. Although still present along the waterways in fair numbers, he has suffered heavily from trapping, chiefly illegal, and is none too plentiful as a result.

While the others have come and gone, two, the red squirrel and the varying hare, locally called the snowshoe rabbit, ever-present in the north woods, have stayed on and are found throughout the island today, probably among the major items on the bill-of-fare of coyote, great horned owl and other timberland hunters.

Outstanding in interest, both historically and numerically, among the mammals of Isle Royale, are the moose. They have brought the island its greatest measure of notoriety, its greatest changes in plant life of recent years, and incidentally have brought Michigan conservation officials a headache of considerable proportions.

The first moose of which there is any positive record reached the island about 1912, apparently having crossed on the ice from Canada during an unusually severe winter which froze the channel between Isle Royale and the North Shore.

This little band—their number is unknown but it is hardly probable that they exceeded a



Natural moose wallows abound on the island and the tumbled, muddy aspect of this wallow shows that it was a favorite of the herd. Such conveniences as this made Isle Royale a veritable moose paradise when the animals first established themselves.

score or so—found a literal moose paradise as far as food was concerned. The island abounded in ground hemlock, balsam fir, aspen, birch, cherry, mountain ash and other trees and shrubs ranking high as winter moose delicacies. The coming of the first spring, unlocking the lakes and bogs, revealed a summer banquet board spread even more lavishly. Lilies and other water vegetation teemed in the more shallow lakes, browse was everywhere and all in all there was little left for a moose to ask for.

The pioneer band settled down in its new range and proceeded to thrive and multiply. It did such an excellent job that in little more than two decades the moose had eaten themselves literally out of house and home and were face to face with winter starvation on a wholesale scale.

When I first saw Isle Royale, in the summer of 1926, I suppose the moose herd was nearing the peak of its abundance or was already at

that peak. Four years later Dr. Adolph Murie of the University of Michigan, after a careful summer survey, estimated there were at least a thousand moose on the island and said there might be even two or three times that many. Experiences with big game population estimates elsewhere led him to suspect that the larger figures might well be more nearly correct.

It is not easy to imagine the abundance of moose on Isle Royale at that time.

Their broad trails led everywhere, through the swamps and over the ridges. Their wallows and feeding places were on every suitable lake and at every natural salt lick. To see a dozen to twenty feeding along the shore of a shallow lake at one time was no rare experience throughout July and August and it was as safe to guarantee the visitor to Isle Royale a sight of moose as a sight of Lake Superior or fir trees.

Certainly in those years the Isle Royale moose herd was the largest in this country east



(Left). Large areas of the island were covered with thick growths of succulent ground hemlock when the moose first came. (Right). Overbrowsing caused conditions like this and today there is comparatively little of the hemlock left.

It had been rumored since 1926 that the moose herd was dying from starvation and such photographs as this conclusively proved that the rumors were right. The herd had increased to such a size that the supply of browse was eaten down to the exhaustion point.



of the Mississippi and perhaps the most heavily concentrated in the world as a result of its limited range.

In that concentration and limited range lay the seeds of inevitable trouble. From 1926 on, forecasts that the moose herd faced a shortage of winter food began to be heard more and more frequently.

Those charged with responsibility for the situation, however, were reluctant to discuss it frankly and for a time the gloomy predictions were largely minimized in the public mind as having been inspired by hunters desirous of an open shooting season on the island moose.

In February of 1934 the storm broke. From the Holger Johnson family, wintering that year at their lonely home on Chippewa harbor, came short-wave radio reports that moose were dying by the hundreds. At first discounted by state game officials, the reports have since proved no exaggeration. The Michigan Conservation Department now estimates that as many as 400 moose, perhaps more, died of hunger on Isle Royale that winter, their supply of browse eaten down to the exhaustion point. For the winter of 1934-1935 the Department estimates the loss by starvation at between 150 and 250, with the admitted possibility that it may have been much heavier.

When the first snows blanketed the Isle Royale ridges last November, Paul Hickie, mam-

malogist of the Michigan Department, who probably knows more now about the Isle Royale moose and their situation than any other man living, estimated that not more than 400 to 600 animals remained alive of the once mighty herd.

There has been little Michigan could do to alleviate this trying situation. What could be done has been undertaken.

Owing to the inaccessibility of the island in winter, the lack of roads, the exceedingly rough terrain and the lack of knowledge as to whether the hungry moose would accept rations of hay, feeding artificially was not thought practicable.

Discarding that form of relief, state game men turned to the plan that seemed most feasible, the live-trapping of the animals to reduce by at least a fraction the size of the herd and also in the hope of establishing a moose herd on the mainland of Michigan's Upper Peninsula, where stray moose have been reported from time to time in the past.

The trapping was begun early in the winter of 1935, purely on an experimental scale. A two-man crew was established on the island, live-traps and corrals were built and drift fences put up to guide the moose to the traps.

The trapping and handling of the animals proved to present no major difficulties. A total of eighteen was trapped during the winter. Of these, eleven were held in the corrals until spring, the maximum number for which the crew



(Left). Trapping of moose began in the winter of 1935. Here is shown a cow moose in the corral. (Below). Captive moose in the trap constructed by a crew sent to Isle Royale by the Michigan Department of Conservation.

(Lower photo by Michigan Department of Conservation)



could cut feed. Hickie, in charge of the project, estimated that fifty moose could have been trapped without difficulty had facilities for handling them been available.

Of the eleven kept, two went to a Detroit zoological park. The remaining nine were sent across Lake Superior in crates and released in the Cusino Game Refuge near Munising, where it is hoped they will repeat the record set by their ancestors on Isle Royale.

Encouraged by the results of the live-trapping, the Conservation Department decided to attempt it again this last winter on a much broader scale. Corrals and traps were made ready by CCC labor and plans were laid for the capture and transfer to the mainland of up to one hundred moose.

As this is written, in mid-winter, the results have been none too satisfactory. Of the first twelve animals trapped, seven died from their struggles in the traps or corral. This contrasts most unfavorably with a total loss of one moose the winter before.

At this writing the corral holds only a score of moose and the preponderance of bulls over cows is overwhelming, suggesting the interesting possibility that the cows, carrying calves, may suffer more quickly from the rigors of hunger and cold and so may have died in far greater relative numbers the last three or four winters.

How effective this winter's trapping project is to be, either in reducing the island herd or contributing to the "colonizing" experiment on the mainland, remains to be seen. The outlook, however, is not too rosy just now.

Nor is it safe to predict with any positiveness the future of the Isle Royale moose. Probably, however, they must continue to follow the downward path until no more than a handful remains, when the balance will be struck between the survivors and their winter food supply and the slow upward climb will begin.

Unless, of course, the United States Parks Service comes into the picture with a constructive and humane solution, as yet apparently not in sight, to change the grim and inexorable course that nature seems destined to take.



When winter closes down on Isle Royale and heavy frost decorates the tops of the birches, the wild scenery takes on a new beauty from the contrast with the dark green of the spruce and fir. This is Chippewa Harbor on a late winter morning.

The Egg-life of a Deep-sea Eel

Its Development has been Photographed to the Larval Stage; Now it Remains to Connect the Larva with the Adult Form

WILLIAM BEEBE

THIRTY-FIVE years ago, in an early number of the BULLETIN, I published one of my first photographs, that of a European turtle dove which had been brought to the Zoological Park. From this time on, photography played a prominent part in the work of the Department of Birds, and later in the activities of the Department of Tropical Research. Thousands of stills were taken in India, Borneo, South America and the Galápagos, and dozens of reels of motion pictures of anteaters, snakes and birds in the tropical jungles. In the Galápagos, slow-motion revealed the amazing flight of the man-o'-war birds and boobies, while photographic plates in color perpetuated the hues of Haitian fish, and full-timed films were obtained fathoms deep beneath the surface of the ocean. Year by year the cream of all these has been shown at Annual Meetings to members of the Zoological Society.

Television has, so far, been beyond our ability, but on our last two expeditions to Bermuda, in the intervals of bathysphere activity and deep-sea trawling, we accomplished a really new achievement in nature photography.

For several years I had been studying the pelagic eggs of fish, netting them at the surface far from land and hatching them on the laboratory table at New Nonsuch. One type of egg in particular, that of an unknown eel, was of large size, exceedingly transparent, and unusually hardy, going through its entire development in the confines of a small watch crystal, and with no change of water. Its photographic possibilities appealed to me and I had an elaborate camera constructed. For the manifold details and exquisite accuracy of this instrument I have to thank Mr. Maurice Ricker of the United Research Corporation, and for its successful operation Mr. John Tee-Van of the Department of Tropical Research staff is entirely responsible.

Our success has been far beyond our hopes, and at the second trial one thousand feet of continuous exposure was obtained, which showed the complete development of the eel, from the time when the first layer of cells crept over the yolk, up to the moment of breaking through the egg wall, and the subsequent free swimming of the infant fish.

In brief, our method is as follows: we set out from the laboratory in our launch, the *Skink*, through Castle Harbor, passing Nonsuch Island, and on three or four miles out to sea. Here one of our regular, silk, deep-sea, metre nets is put over the stern, and towed slowly at the surface for ten minutes, at the end of one hundred feet of rope. It is then pulled in, and the *Skink* is headed swiftly back to shore. The quart Mason jar is untied from the canvas collar at the bottom of the net, and placed at once in a pail of ice. When we reach the laboratory the jar is allowed to stand quietly for half an hour. Then, armed with medicine droppers and hand lens, I examine the surface of the water for floating eggs.

In a short daylight haul such as this there is very little plankton, a few sagitta, worms and small shrimps, a scattering of copepods, a score or more of inappropriately named *Noctiluca*, and from one egg to several hundred eggs of marine fish. The most abundant are round, small in size, about a fortieth of an inch in diameter. These are of many species, some clear, others with varying numbers of oil globules, some with the outside smooth, others with a coating of fine, short hairs. A second abundant type is larger and shaped like tiny spindles with the tapering ends rounded—these being, very probably, some species of anchovy or sardine. It seems to be a rule that the smaller the egg the quicker it hatches and some of these diminutive ova complete their entire development in twelve to twenty-four hours.



From the quart jar into which the net has drawn a variety of minute marine organisms, a perfect eel egg is selected and isolated in a tiny pool that can be set upon the stage of the camera.

Now and then a larger sphere comes into the field of vision of my hand lens, so transparent that only the periphery is visible. There may be one, or rarely as many as a dozen, and they are comparative giants—measuring three and a third millimetres across, or about an eighth of an inch.

The positive specific gravity of these eggs is so delicate that the slightest tap will send them almost to the bottom of the jar, and they often require a full half hour again to reach the surface. Gentle suction of the medicine dropper draws them up, and they come to rest in their last home—the diminutive pool of a watch crystal.

We select an egg in the earliest stage of development and in perfect condition, showing no dents, or beginnings of foreign growth upon its surface. It is placed on the stage of the photographic camera and, the clockwork and electric mechanisms started, we pray for success.

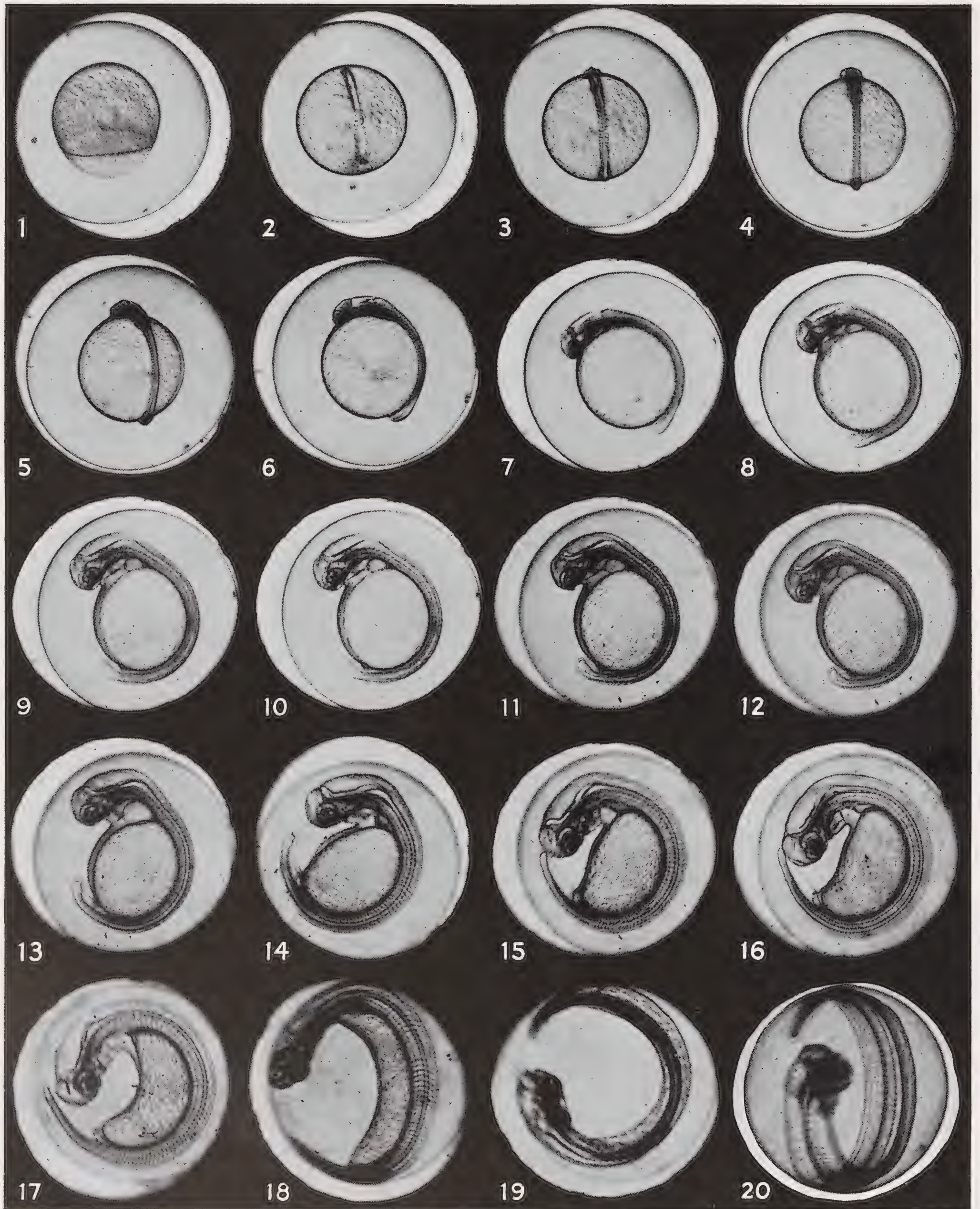
The instrument combines a microscope, light source, condensers and other necessary optical equipment with a standard-size motion picture camera driven by electric motors. It is controlled by a simple timing mechanism, a slowly revolving, endless strip of 16-millimetre film, with holes punctured at certain definite intervals. The calculated arrival of these holes on a metal stage allows the successive contact of mercury switches. This permits the frames of

the motion picture film to be exposed at any desired intervals, or, if required, the intermittent device can be removed, and the camera operated at full speed. This is often necessary during the later stages of development, as the muscles become functional before hatching, and the embryo stirs and twists about.

We set the exposure interval at one every sixty seconds, with the knowledge that this particular kind of egg will hatch after seven days and seven nights. Thus we have finally, on a film run at normal speed, the week-long, entire development of the eel projected on the screen in fifteen or twenty minutes. Or, as has been done for the purpose of illustrating this article, selected single frame negatives can be isolated and printed.

This is the general process, but in addition to the above-mentioned prayer for success in which we all join, the photographer must be on the watch or at least within reach almost all the time. Mr. Tee-Van rigged up an ingenious electric adjunct of the camera by which, in case of any accidental stopping of exposures, a red bulb flares in his face by his bed, and awakens him.

Photographing a floating fish egg as it grows is not an easy process. The egg must be kept alive, which means that fresh salt water of the correct salinity, density and temperature must be supplied to make up for evaporation; for unlike the study specimens on my laboratory



This series of pictures shows twenty out of more than ten thousand frames from a continuous motion picture record of the embryonic development of an unknown deep-sea eel. An explanation of the various stages will be found in the article.

table, the one on the photographic stage cannot be protected by a cover of glass. Precautions must be taken to prevent the slightest jar to microscope or camera, although, in the main, this is taken care of by the fact that the base of the camera is attached to a pediment of concrete which rests on the actual mother rock of Bermuda. The water must not be disturbed by any draft or slightest movement of the air in the room; dust must be kept from falling on the surface; and the water must not be heated by the intermittent illuminating lamp. Finally, in order to obtain a steady, clear picture, the egg must remain in one position while being photographed. After many experiments this problem was solved by confining the egg within a minute section of a circle of glass, sawed from the tip of a medicine dropper, the equator of the egg resting just at the upper rim of the glass. The latter, when photographed, appears as a wide dark frame about the transparent egg.

The story of embryology, or the natural history of life within the egg, is difficult to put into simple, understandable language. In the present instance, the transparency of the egg and the unbroken series of pictures make it easier.

The history of my egg before I lift it from the sea is probably as follows: far down below the surface some great deep-water, female eel deposits it in mid-sea, and some male eel fertilizes the egg while it floats in the cold darkness. It then rises slowly toward the surface, and as it ascends it passes through the earliest stages which are common to all animal life, and which are as yet utterly mysterious and inexplicable.

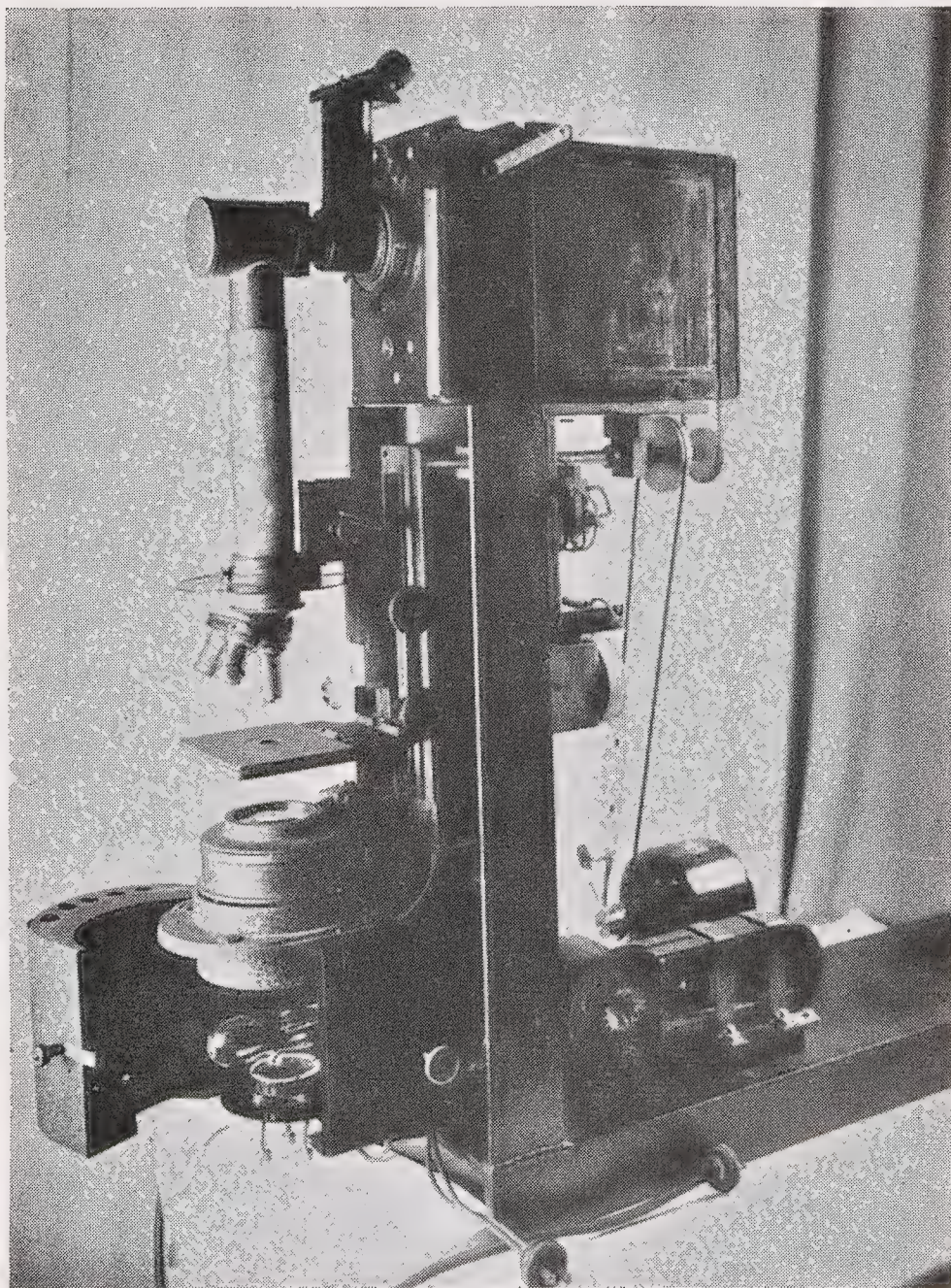
Considered as a whole, the egg is a single round mass of yolk confined by a transparent but strong outer membrane. At the top of the egg (using that word for convenience, for actually there is no top or bottom) is a slightly thickened, saucer-shaped mass of protoplasm, darker than the yolk, which is known as the blastodisc. *Blast* is a Greek word meaning germ or primitive, which thus makes clear this and the following combinations of syllables.

Soon after fertilization, this disc slowly divides into 2 equal cells, to which is now given the name of blastoderm, or primitive skin. These 2 cells divide again at right angles into 4, then still again into 8, 16, 32, 64, 128 and so on until this end of the egg consists of a finely-divided

froth of thousands of cells. As the increase continues, they spread out and downward over the surface of the whole egg into a real blastoderm or skin of cells.

At this point the egg reaches the surface, is caught in my net and rushed on to the stage of the time-lapse camera. As the blastoderm creeps down over the yolk, the speed of development increases and at one stage of the motion picture the myriad cells can be seen dividing as they advance, like a rushing maelstrom of life. Extending along one side a shadowy form may be seen, which is the first indication of the embryo. Its head will be near the spot of the original single cell, and its body is drawn out in the wake of the eclipsing veil of the blastoderm. After six or eight hours under the camera (comprising nearly five hundred exposures) we find the blastoderm drawing together at the "bottom" of the egg. This closing aperture is called the blastopore, a word which is self-explanatory, and this point will form the tail end of the embryo.

The surge of life is now so swift that the



Clockwork and electricity operated the time-lapse motion picture camera to photograph the egg development.

film has to be seen several times to follow all the changes. In Fig. 2 the blastopore is almost closed, the form of the embryo is distinct, several cross divisions midway hint of the coming vertebrae and toward the tail there is a deep trench, with rising waves of tissue on each side, which, when they close, will form the hollow tube which will contain the central nervous system.

In Fig. 3 the head and eyes are already evident and on the film the faintest of heart beats can be detected. In Fig. 5, about 32 hours after the start, a strange thing happens: the embryo begins slowly to revolve until the eel is in profile along the circumference, in the most perfect possible position for photographing all the succeeding development of the body. And there it remains throughout the rest of the time. The orientation takes about one-half hour.

From here on, Figs. 6 to 18, the superficial changes are relative and continuous. The yolk is gradually absorbed, its contour altering from a full moon to a gibbous (Fig. 14) and finally to a slender crescent (Fig. 18). The head becomes greatly enlarged, the fore and mid-brain swelling, and the large eyes rounding out. The heart beats steadily, and in the later stages (Fig. 16) shows clearly its two chambers, the auricle and ventricle, and the sinuous path of the liquid being pumped throughout the body. The number of the primitive vertebrae increases, and when they reach one hundred we may be sure this is a species of eel. The tail becomes free from the yolk as early as the fifty-sixth hour (Fig. 7) and the head lifts clear a day later. In Fig. 15 the head and tail touch.

At about the hundredth hour, an unexpected thing happens, which is not shown in the isolated prints illustrating this article. The embryo begins to hitch itself around the egg, keeping exactly on the equator. It revolves ten times in the course of four hours. Only a continuous series of motion picture photographs could ever reveal this first movement, but even this gives us no idea of how it is done. There is no lever or fulcrum, and the embryo is floating free in the liquid of the egg.

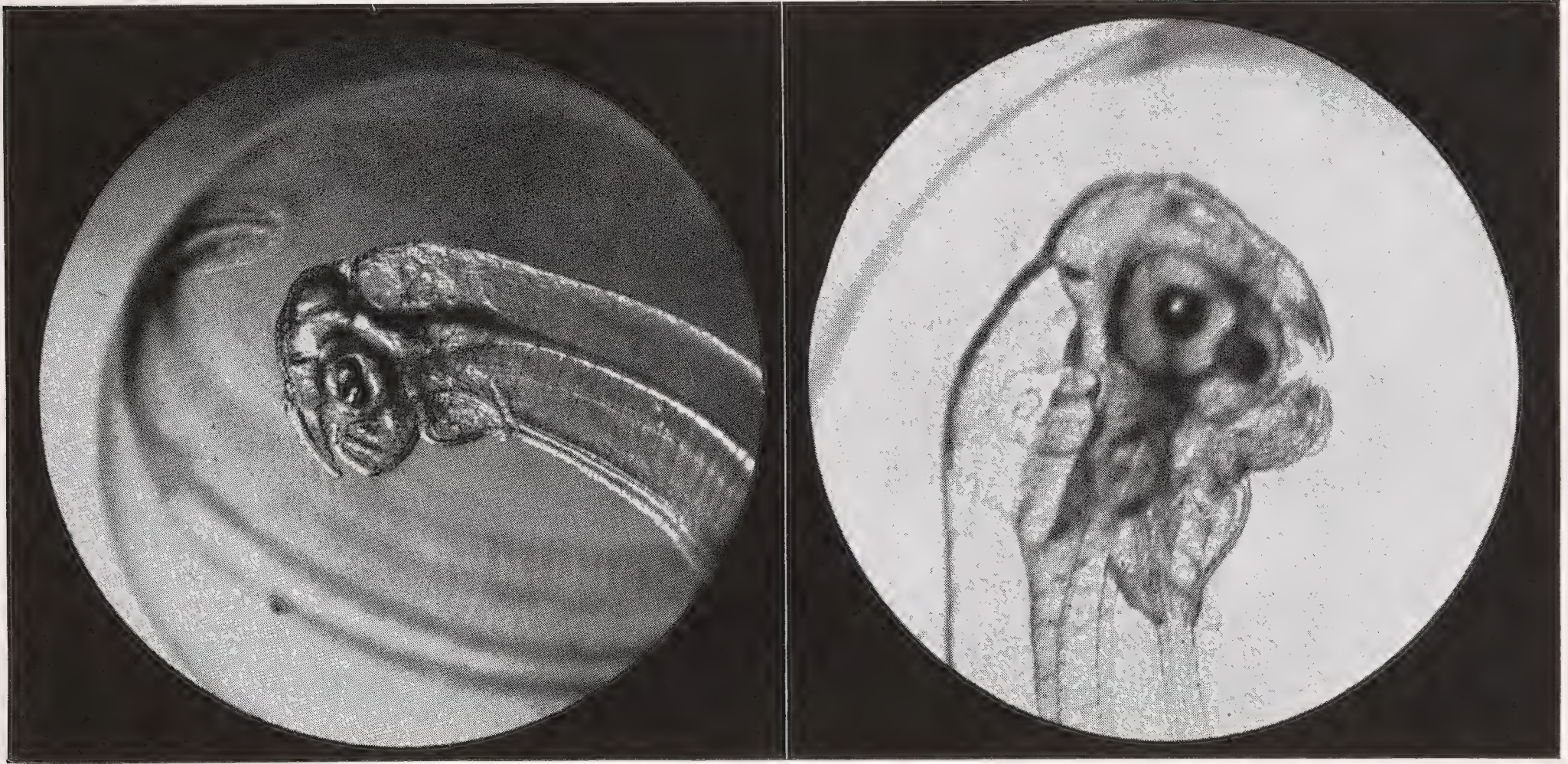
The final stage of development of the great eel egg is the most dramatic and spectacular (Fig. 20), and in place of the solid, homogeneous mass of the first day there is a sphere

of glass within which the perfect little eel twists and turns and revolves. It is now afloat in its own private sea, bounded by a globe clear as crystal, yet so impermeable that it is an effective barrier to the hordes of bacteria and protozoa which swarm without. The larva has now grown until it extends once and a quarter around the inner circumference of the egg. It cannot stretch out straight but it can twist and bend, first to one and then to the other side.

As far as possible it uses all its new-formed muscles. Steadily the heart beats—156 throbs to the minute—and after every muscular spasm the beat is somewhat more rapid. The parrot-like jaws open and close, champing together like the gums of a toothless old man, and within the transparent cartilage the future needle fangs are clearly visible, showing as alternate ribs and furrows (illus. p. 65). The eyes move in their sockets, as yet seeing nothing, for the egg floats alone in its secondary ocean of laboratory glass. The rounded pectoral fins fan the fluid in the egg, useless as yet, but ready for their future balancing function. Even the tiny, hair-like, sensory organs along the sides are developed, all aquiver for the recording of varying pressure waves in the water.

The last act in the egg-life of this eel is not unlike that of the chick. If we watch it steadily under our laboratory microscope, the embryo is seen to alternate violent contortions with periods of quiet. The movements appear haphazard, but if we observe carefully, the head comes to rest again and again near the same spot. In the last egg studied the great beak returns constantly to a place which, considering the egg as a planet, would be some 32 degrees north of the Equator, or about the latitude of Bermuda.

The embryo is now 370 to 380 degrees of the egg's circumference when it is flattened against the inner wall, and when in this position the head and jaws are sideways to the egg lining. Now and then the eel coils up tightly, so that its body forms two and a half small, flat spirals. It then partly uncoils with a slow, scraping motion, its head at right angles to the egg wall, bringing the tip of the beak against the side. The jaws form a perfect macaw's beak in miniature, the upper mandible projecting, curved and sharp, the lower short and inbent, leaving the upper free for its eroding action on the Bermuda area.



The nearly-hatched eel embryo may be seen on the left, with the fangs appearing in both jaws. The picture on the right shows the head of a late embryo, displaying the eyes, ears, brain, notochord, heart and jaws resembling the beak of a parrot.

If our patience holds out, this place, after a while, is seen to be marked by a slight bulge on the outside of the egg. Now, during periods of quiescence, the neck muscles move and the sharp beak, like the egg-tooth of a chick, continues to rub up and down against the inner lining.

I have found dead eels half in, half out of their eggs, but I have never actually observed a prolonged emergence. The jaw breaks through, the head follows and with one or two convulsive jerks the eel is born, while one more twist sends it clear away from the egg. The two sides of the tear close behind it, and a second afterward the egg, still perfectly round, has its surface disfigured by only the faintest indication of a short, neat seam.

If we allow the empty egg to remain in the same dish with the eel, it will complete the cycle of life, birth, death and dissolution which recognizes no distinction in size or caste, operating equally in protozoan, fish and man. Although the seam of escape appears to our coarse sight to be tight closed, it is far otherwise to the hosts of protozoans which for days have been crowding the outer surface of the egg, as we humans creep about upon our planet. To these one-celled scavengers the slit is an open

gateway, and they rush in and seem to find rich sustenance in the embryonic residue. Hour by hour, like a slowly deflating balloon, the egg crinkles and collapses, and finally it is reduced to an amorphous heap of unrecognizable detritus on the bottom of the watch crystal. In Burma I have seen scores of griffon vultures, piled two and three deep upon the last of a buffalo's carcass. Here, a high-power lens reveals generations upon generations of protozoa battenning upon the last of the egg.

We left the new-hatched eel resting a short distance away from the empty ovum. Like the just-emerged chick, it seems impossible that he could ever have been confined within such a diminutive sphere. A short time after emerging he measures eleven millimetres, or almost half an inch, from head to tail, which, in respect to his egg, is considerably more than π . He is as flat and transparent as a sliver of cellophane. In common with all larval eels, he has a general name, *leptocephalus*, and in this stage he is as unlike his full-grown parent as a caterpillar is unlike a butterfly.

Spells of activity now begin, slight at first but increasing in violence until, without making any appreciable progress in the water, he wriggles so rapidly that the motion picture shows

only the two end postures, and the general effect is of a one-headed eel with two bodies.

Within a day's time he has learned to orient his body, to keep it right side up, to swim slowly straight ahead, and to dart from side to side of his elfin sea. His pectoral fins move rhythmically, his green iridescent eyes roll about and see, his parrot jaws open and shut. In a short time the tissues about the beak shrivel and the fangs protrude more and more, until we have before our eyes a change as from parrot to sabre-toothed tiger, and the great needle-like teeth are bared to their roots. If this little creature were forty feet long he would put to shame every effort of man's imagination in the direction of dragons or sea-serpents.

For five or six days after hatching the *leptocephalus* thrives. His slender, remaining store of yolk is finally absorbed, down to the last visible grain. The little creature increases in size and perfects the manipulation of his various organs. Then he droops and dies. Judicious use of certain vitamins in the water have so far increased but slightly his span of life. If placed in a deep container he swims to the bottom and remains there, so one lethal factor is probably the inability to sink to deeper levels. We never capture *leptocephali* at the surface in mid-day, so at sea they must sink far down.

Our next problem is to connect this larval stage with the adult, whatever deep-water form it may be.

Memorial to an Almost-vanished Bird

The Gallery of Wild Animal Paintings Acquires a Lovely Canvas
of the Ivory-billed Woodpecker

WILLIAM BRIDGES

"**T**HERE goes a Vandyke!" James John Audubon used to exclaim to himself when, a solitary wanderer in some gloomy swamp or forest glade, he looked aloft to see the graceful swoop of an ivory-billed woodpecker from one tall tree to another. For it was the naturalist's happy fancy that in the dark glossy body and tail, the white markings, the brilliant yellow of the eye and the rich carmine of the male crest, "there is something very closely allied to the style of colouring of the great Vandyke."

In the period when Audubon was preparing his monumental "The Birds of America," a little more than a hundred years ago, the ivory-billed woodpecker was not particularly uncommon if one had the hardiness to penetrate the wilderness. But today the largest of the North American woodpeckers is precariously balanced on the precipice of extinction and few are even the naturalists who have seen it alive or possibly ever will.

It is all the more fortunate, then, that the Society has been able to acquire a memorial to an almost-vanished bird that faithfully and worthily depicts it. In all probability the ivory-billed woodpecker will never be seen in cap-

tivity—it is doubtful if a creature of its temperament and habits could long survive restriction, even if it were possible to try the experiment—but in the Society's collection of Wild Animal Paintings it will live for future generations in authentic representation.

The canvas was painted by Dr. George M. Sutton, the Curator of Birds at Cornell University and a bird artist of distinction. He accompanied the recent American Museum of Natural History-Cornell University expedition into the southland to photograph the rarer birds and record their voices and the painting was the result of observations made in a Louisiana swamp.

While Dr. Sutton was engaged in transferring the living colors to his sketchbooks, Dr. A. A. Allen succeeded in capturing the form and flight and strident voice of the birds on motion picture film. His remarkable camera record was shown to members of the Society at the Annual Meeting last January.

The story of the ivory-billed woodpecker, like that of so many forms of our wild life, has been one of continuous decline as the wilderness was pushed back and hunting proceeded unchecked. A civilized man may find it difficult to think of a



IVORY-BILLED WOODPECKERS

A Painting by George M. Sutton, Now in the Gallery of Wild
Animal Paintings of the New York Zoological Society.

woodpecker—even such a large woodpecker as the ivory-billed—as a “game bird,” but in 1895 Arthur Trezevant Wayne reported of the Wacissa region in Florida that:

“This magnificent bird was once very common in this region—a country especially adapted to its wants—where it was in a large measure secure, but is now rapidly becoming extinct on the Wacissa. Every one is shot by being systematically followed up. They are shot for food, and the people—the crackers—consider them ‘better than ducks.’ The bill is also prized and many fall victims for that reason.”

The head of the male, with its flaming red crest, seems to have made the bird the object of “scalp hunters’” guns since early days, for Audubon remarked that it “forms an ornament for the war-dress of most of our Indians, or for the shot-pouch of our squatters and hunters, by all of whom the bird is shot merely for that purpose.

“Travelers of all nations are also fond of possessing the upper part of the head and the bill of the male, and I have frequently remarked, that on a steamboat’s reaching what we call a *wooding-place*, the *strangers* were very apt to pay a quarter of a dollar for two or three heads of this Woodpecker. I have seen entire belts of Indian chiefs closely ornamented with the tufts and bills of this species, and have observed that a great value is frequently put upon them.”

Indians in the southern regions considered the heads and bills a potent charm, as well as a decoration, and Alexander Wilson in the early years of the past century reported them worn as amulets and sold to the northern tribes at considerable prices.

Through the agency of aesthetic Indians then, it may be supposed that the numbers of ivory-billed woodpeckers were generally kept within bounds. Certainly it is fortunate for the species that the white inhabitants of the haunts of the bird often had to be saving of their powder and shot, or destruction would have been even more rapid. Wilson comments that the natives usually confused the ivory-billed and the pileated woodpeckers, which they called “log-cocks,” because they usually observed them only at a distance, “gunpowder being considered too precious to be thrown away on Woodpeckers;

nothing less than a Turkey being thought worth the value of a load.”

Ignorance of the value of birds as destroyers of harmful insects has always led to the slaughter of economically useful species and the ivory-billed woodpecker in its day suffered along with other birds. Wilson struck vigorous blows in its defense, pointing out as an object lesson the road from Georgetown to Charleston, South Carolina, where whole woods stood stark and dead from the ravages of insects.

“And yet,” he went on, “ignorance and prejudice stubbornly persist in directing their indignation against the bird now before us [the ivory-billed woodpecker], the constant and mortal enemy of these very vermin, as if the hand that probed the wound to extract its cause, should be equally detested with that which inflicted it; or as if the thief-catcher should be confounded with the thief.

“I would humbly suggest,” he added, “the propriety of protecting, and receiving with proper feelings of gratitude, the services of this and the whole tribe of Woodpeckers, letting the odium of guilt fall on its proper owners.”

He and other naturalists insisted that the ivory-billed woodpecker does not seriously harm living trees—a fact that is only mildly controverted today. It nests in living trees, it is true, although occasionally a dead tree may be chosen, but the nest-hole is small and there is no wanton destruction of the tree. Nevertheless, the writings of the early naturalists indicate that there must have been a time when the king of woodpeckers was relentlessly hunted as a destroyer of timber. Wilson showed the reason why:

“Wherever he frequents he leaves numerous monuments of his industry behind him. We there see enormous pine trees with cartloads of bark lying around their roots, and chips of the trunk itself in such quantities as to suggest the idea that half a dozen of axemen had been at work there for the whole morning.”

Similar evidences of the demoniacal energy of the bird in its search for insects under the bark of dead trees came under Audubon’s observation. “I have seen the remains of some of these ancient monarchs of our forests so excavated, and that so singularly, that the tottering fragments of the trunk appeared to be merely supported by the great pile of chips by which its

Although the ivory-billed woodpecker as a rule builds its nest in the sound trunk of a living tree, it may take advantage of easier nesting conditions in partly decayed wood, as it did in this towering maple in a Louisiana swamp. The nest, with one bird clinging to the trunk at the side of the hole, was photographed by Dr. A. A. Allen. The nest was 43 feet from the ground.



base was surrounded," he wrote. "The strength of this Woodpecker is such, that I have seen it detach pieces of bark seven or eight inches in length at a single blow of its powerful bill, and by beginning at the top branch of a dead tree, tear off the bark, to an extent of twenty or thirty feet, in the course of a few hours, leaping downwards with its body in an upward position, tossing its head to the right and left, or leaning it against the bark to ascertain the precise spot where the grubs were concealed, and immediately after renewing its blows with

fresh vigor, all the while sounding its loud notes, as if highly delighted."

That "loud note," incidentally, often led to the bird's destruction. Several naturalists mention the insistence of the call and Audubon's experience led him to declare that there were few minutes during the day when the bird was silent. It was an easy matter for hunters, therefore, to trace and kill a bird which advertised its presence and its location so continually. The call seems to be somewhat deceptive. Wilson thought it clearly audible half a mile away, al-

though "seeming to be immediately at hand."

When the ivory-billed woodpecker shall have become extinct, Dr. Allen's sound-record of its voice will perhaps be able to give scientists a more accurate account of what it really sounded like than the words that naturalists have used to describe it. Wilson, for instance, said that it "resembles the tone of a trumpet, or the high note of a clarinet." Audubon, attempting to express the call by the monosyllabic "*pait, pait, pait,*" said the note is usually repeated three times in succession and "resembles the false high note of a clarionet." Robert Ridgway thought the note "not as loud as those of the Red-bellied Woodpecker" and compared it to "the toot of a child's penny trumpet," while S. C. Graham was reminded of "the burry reed notes of a Scotch bagpipe" and wrote down the notes as "*pee-peep-peah, peep.*"

The Allen sound record makes it libelous to compare the note to the product of any musical instrument, be it clarinet, bagpipe or even penny trumpet, for there are few bird calls as nasal and unmusical as that of the ivory-billed woodpecker.

A survey of the early accounts of the bird's natural history make it easy to understand why its numbers have declined. Restriction of the forests that are its natural habitat and ruthless hunting for food or ornament have accounted for it. Nevertheless, rapid as has been the shrinking of the wilderness, it is rather surprising to discover what an extended range the bird once possessed.

Audubon defined its limits in his initial account of the bird—the range that it enjoyed in the first quarter of the past century.

"Descending the Ohio," he wrote, "we meet with this splendid bird for the first time near the confluence of that beautiful river and the Mississippi; after which, following the windings of the latter, either downwards toward the sea, or upwards in the direction of the Missouri, we frequently observe it. On the Atlantic coast, North Carolina may be taken as the limit of its distribution, although now and then an individual of the species may be accidentally seen in Maryland. To the westward of the Mississippi, it is found in all the dense forests bordering the streams which empty their waters into that majestic river, from the very declivities of the Rocky Mountains. The lower parts

of the Carolinas, Georgia, Alabama, Louisiana, and Mississippi, are however, the most favourite resorts of this bird, and in those States it constantly resides, breeds, and passes a life of peaceful enjoyment, finding a profusion of food in all the deep, dark, and gloomy swamps dispersed through them."

The most recent attempt to define the limits of the ivory-billed woodpecker show what civilization and hunting have done. Arthur H. Howell's "Florida Bird Life" comments:

"Now nearly exterminated except in a few localities in Florida; possibly still exists in parts of Texas, Louisiana, and Mississippi."

The bird is, of course, rigidly protected by law, but laws are not always effective. In 1924 Dr. Allen observed and photographed a pair of ivory-billed woodpeckers in a certain locality in Florida, but despite attempts at keeping the site secret, his visit was followed by that of a taxidermist, who shot the birds and mounted them. Thus, for the sake of a few dollars that the mounted birds might bring, the species was hastened that much nearer to extinction.

The ivory-billed woodpecker is said to nest and roost usually in cavities it digs in living trees from thirty to fifty feet above ground. Usually a towering cypress is chosen, but the bird may select a pine bordering a thick swamp, a palmetto, a bay, a gum or some other tall tree. Rarely the nest is in a dead tree, but the wood must be sound and solid. The bird seldom makes use of rotting wood except when indulging its insatiable appetite for insects.

Ordinarily, as in the painting by Dr. Sutton, the nest site is chosen just below a projecting branch or stump of a branch. The entrance is oval and runs horizontally into the tree for a few inches, then drops straight down. Early naturalists had the idea that the hole was spiral, for purposes of protection, but Audubon found that this was not the case. Fourteen inches to three feet deep, the hole ends in a rather rude nest of chips and in this the female deposits her eggs—three or four and sometimes five. They are pure white.

"Both birds work most assiduously at this [nest] excavation, one waiting outside to encourage the other, whilst it is engaged in digging, and when the latter is fatigued, taking its place," Audubon wrote. "I have approached trees whilst these Woodpeckers were thus busily

employed in forming their nest, and by resting my head against the bark, could easily distinguish every blow given by the bird. I observed that in two instances, when the Woodpeckers saw me thus at the foot of the tree in which they were digging their nest, they abandoned it for ever."

The ivory-billed woodpecker is said to nest earlier in the spring than any others of its tribe—as early as the latter part of January, continuing into April. Audubon observed young birds around the entrance to the nest about two weeks before they ventured to try their wings in flight to another tree. He declared that a second brood comes off about mid-August.

Successive broods probably remain fairly close to their home area, for the bird is not migratory. Indeed, it would appear from Audubon's description not to be fond of extended flight.

"The flight . . . is graceful in the extreme, although seldom prolonged to more than a few hundred yards at a time, unless when it has to cross a large river, which it does in deep undulations, opening its wings at first to their full extent, and nearly closing them to renew the propelling impulse," he wrote. "The transit from one tree to another, even should the distance be as much as a hundred yards, is performed by a single sweep, and the bird appears as if merely swinging itself from the top of one tree to that of the other, forming an elegantly curved line. At this moment all the beauty of the plumage is exhibited, and strikes the beholder with pleasure."

Both Wilson and Audubon mentioned the dangerous use the bird can make of its claws and beak when captured and the "piteous cry" it utters when taken. The peculiar cry impressed Wilson extremely and gave rise to an anecdote that he recounts in "American Ornithology."

The first bird he obtained was taken near Wilmington, North Carolina, he said. "This bird was only wounded slightly in the wing, and on being caught, uttered a loudly reiterated, and most piteous note, exactly resembling the violent crying of a young child; which terrified my horse so, as nearly to have cost me my life. It was distressing to hear it.

"I carried it with me in the chair, under cover, to Wilmington. In passing through the streets its affecting cries surprised every one

within hearing, particularly the females, who hurried to the doors and windows with looks of alarm and anxiety.

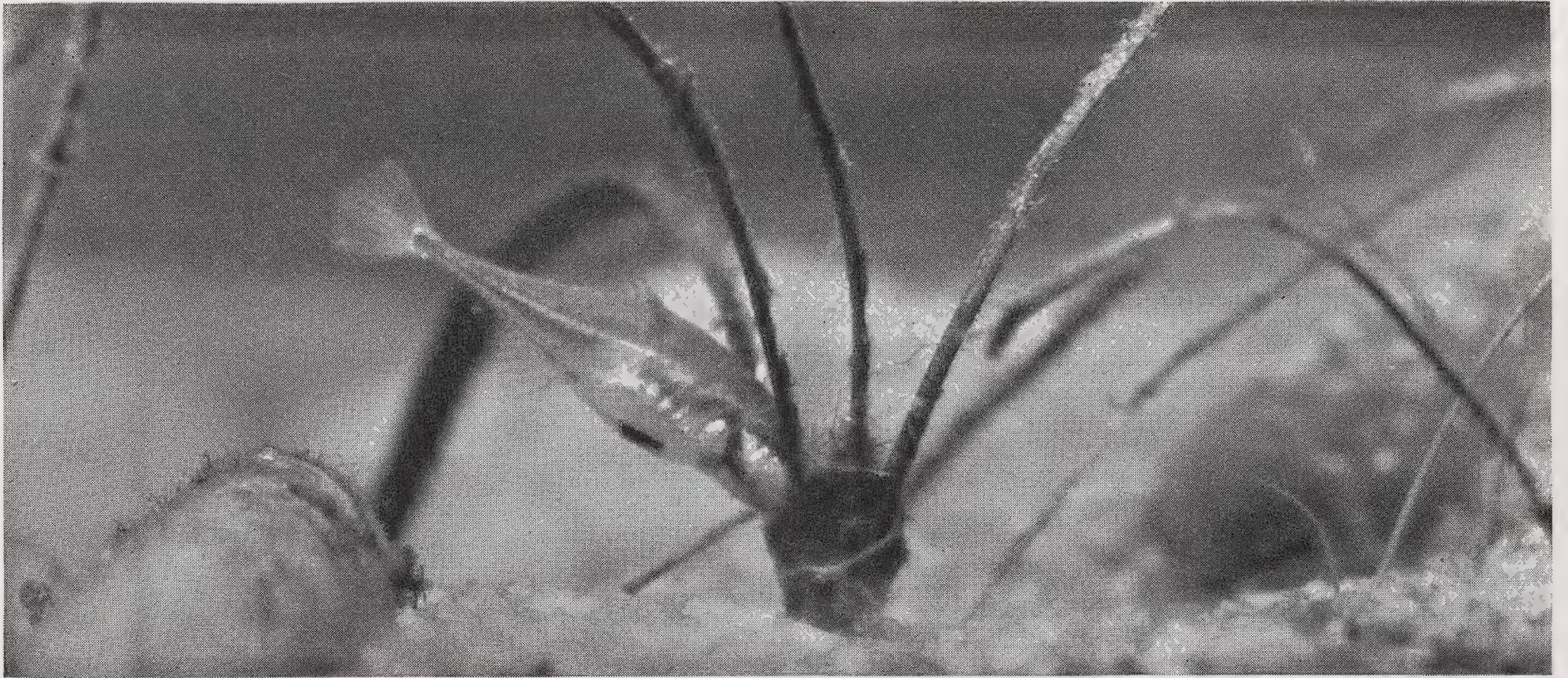
"I drove on, and on arriving at the piazza of the hotel, where I intended to put up, the landlord came forward, and a number of other persons who happened to be there, all equally alarmed at what they heard; this was greatly increased by my asking whether he could furnish me with accommodations for myself and my baby. The man looked blank and foolish, while the others stared with still greater astonishment. After diverting myself for a minute or two at their expense, I drew my woodpecker from under the cover, and a general laugh took place."

The naturalist very nearly had the laugh turned on him by a subsequent happening, however. As he recounts it:

"I took him [the woodpecker] upstairs and locked him up in my room, while I went to see my horse taken care of. In less than an hour I returned, and on opening the door he set up the same distressing shout, which now appeared to proceed from grief that he had been discovered in his attempts at escape. He had mounted along the side of the window, nearly as high as the ceiling, a little below which he had begun to break through. The bed was covered with large pieces of plaster; the lath was exposed for at least fifteen inches square, and a hole, large enough to admit the fist, opened to the weather-boards; so that in less than another hour he would certainly have succeeded in making his way through.

"I now tied a string around his leg, and fastening it to the table, again left him. I wished to preserve his life, and had gone off in search of suitable food for him. As I reascended the stairs, I heard him again hard at work, and on entering had the mortification to perceive that he had almost entirely ruined the mahogany table to which he was fastened, and on which he had wreaked his whole vengeance.

"While engaged in taking the drawing [reproduced in 'American Ornithology'], he cut me severely in several places, and on the whole, displayed such a noble and unconquerable spirit that I was frequently tempted to restore him to his native woods. He lived with me nearly three days, but refused all sustenance, and I witnessed his death with regret."



This male stickleback is at work on a typical nest, tucking bits of plant fiber around the base of an aquatic plant to form the foundation of construction. The picture is more than life size; the fish is about an inch and a quarter long.

“All Modern Conveniences”

A Note on the Nest Architecture of the Four-spined Stickleback

C. M. BREDER, JR.

IF a building contractor undertakes to construct four houses at once he is likely to be a very busy man for a few weeks, but there is nothing very extraordinary about it—except possibly his good fortune in finding so much work.

A fish attending to four nests at once is much more an object of interest and even amazement. He—for it is the male four-spined stickleback, *Apeltes quadracus* (Mitchill), that is the constructor, janitor, policeman and ventilating apparatus of his own apartment building—must be almost unbelievably busy during the period of his multiple nesting.

The nesting of the various sticklebacks of our local waters has been described many times but there seems to be no observations on the extreme activity of the fishes during this period, and that is perhaps the most remarkable feature of it all.

Fishes generally do only one thing at a time. No matter how complex the operation is, its

elements follow in a logical sequence of time. In the nesting of a stickleback, however, several things are going on simultaneously and the fish must in some way be able to keep track of them all. He must alternate his attention rapidly and appropriately in order to rear a successful family.

How does he keep the details straight? Does he become confused—as a human being might very well do under similar circumstances?

Does his “routine” break down under the pressure of finding nesting materials, courting wandering females, ventilating deposited eggs, feeding and driving off marauders?

A number of four-spined sticklebacks have been under observation for some time in the New York Aquarium and perhaps some of the answers to those questions are to be found in our notebooks. But first some general comments on stickleback habits.

It is usually in early May that the sticklebacks of our region take under serious con-

sideration the problem of perpetuating their kind. The males accept full responsibility for the location of their nests—usually at the base of some aquatic growth in brackish tide-water.

For a fish, at least, the nest-edifice that is to

be built is a really complex structure. When it is finished, it may be likened to a modern apartment building of several floors with unexcelled janitor and police services and modern ventilation.



(Top). The weaving operation, showing the cobweb-like strands at the top of the nest. (Lower left). Another fish weaving its nest. (Lower right). Three nests full of eggs or young, and a fourth started. The fish is aerating its first nest, from which the young are already emerging. One of them may be seen at the base of the plant at the right of the nest.



The male of the preceding picture ventilating his second nest before the third one has been completed.

The first task of the would-be father stickleback is the gathering of bits of twig-like parts of small aquatic plants. These are carefully tucked and woven into the base of the foundation plant, as can be seen in the first illustration. When some of these are satisfactorily in place they are further secured by being bound together by a spidery threadlike secretion that binds the whole structure firmly together. This secretion, which hardens into a tough thread on contact with water, is a special product of the kidneys which only the males are able to elaborate.

The second illustration is the same nest as the first and shows the fish in the process of

weaving his thread. The third is that of another nest, not so advanced, in which the male is likewise weaving. This weaving is a most impressive activity, for it is not a simple winding, around and around. There may be two turns in one direction, then a loop about one of the plant stalks, and turns in the opposite direction; or there may be figure-eights over the top of the nest, apparently just as the construction requires. Every so often the fish will back off and eye his work as though appraising his efforts. At such times he usually moves from place to place and back again, exactly as any craftsman criticizing his own work.

Finally a point is reached where the efforts seem to be satisfactory and the serious business of courtship begins. After the females, thus far disinterested, have been induced to lay their eggs in these partially formed nests, there is more work for the father. The nest at the time of egg-laying may be considered about half finished and roughly consists of a cup-shaped basket of plant fibers and woven threads of gossamer. After the eggs are in place the "roof" is put on and the whole bound together in a more or less globular unit. There are always two holes left, however, for ventilation; one on either side of the construction. Other species are reported to build their muff-like nests complete first and then have the female enter it to lay her eggs. With the four-spined stickleback, *Apeltes quadracus* (Mitchill)—the one here illustrated and discussed—this is not the case. As may be seen from the photographs, the nests are too small and compact for the relatively large female to squirm into. The holes left are just large enough for the somewhat smaller male to insert his snout.

After the structure is complete, including its complement of eggs, the real work of the male begins. As his own policeman he must keep marauding enemies away from the succulent eggs, and the marauders include even the female that laid them. Also, as his own janitor, he must see that there is adequate cross ventilation through the one room apartment. This is done by a forced draft pumping system. The mouth of the male is thrust into one of the openings and by means of rapid respiratory movements fresh "outside" water is drawn through the opposite opening. This practise is maintained until the young fish have left the dwelling for good.

Even this exacting activity is not sufficient for the hardworking father stickleback. Alternating with this effort he goes on to building a second story and courting another or the same female. Thus continuing he may finally have an "apartment house" of three or four stories. When the height of activity is reached he is about the busiest thing among fishes that can well be imagined. His activities include at least the following: Ventilating two or more nests alternately, gathering bits of plant for the one under construction, weaving cobwebs, repairing the older nests, courting females, protecting the whole against enemies and occasionally taking a little time out to feed.

The fourth illustration shows a male pumping water through the first nest, with two above it, both containing eggs, and a fourth in the very earliest stages of construction. The photograph was taken just about at the last of the ventilation of nest Number One, for already some of

the young have left that nest. One may be seen hanging on the right-hand plant stem at its base. The two remaining pictures¹ show this same fish first ventilating its second nest before the third was finished, and the last picture was taken just before a female laid eggs in the partly built fourth nest. Her somewhat larger size and different coloration, both of which are typical, may be noted here.

Now, with multiple families, multiple nests and multiple duties, how does the stickleback manage to keep everything straight and in perfect sequence?

The answer is, that while he makes a pretty good job of it, he does slip a cog now and then. Here is a transcription from observations made on May 18, 1935, of a stickleback working on two nests that both contained eggs, while proceeding with the building of a third nest:

¹ All the photographs were taken by S. C. Dunton.

This is the same nest as the one on Page 74 and the lower right picture on Page 73. The male and a female, the latter the larger fish, are approaching the structure just before the eggs were deposited in the partly-finished fourth nest.



<i>Time A.M.</i>	<i>Activity</i>	<i>Aeration</i>
10:22	Aerated nest No. 1, about 10 seconds	No. 1
:22 $\frac{1}{4}$	Sought fragments for nest No. 3	
:23	Aerated nest No. 1, about 10 seconds	No. 1 (not No. 2)
:23 $\frac{1}{4}$	Wandered off (feeding?)	
:24 $\frac{3}{4}$	Aerated nest No. 1, about 8 seconds	No. 1
:25	Pursued female	
:26	Aerated nest No. 2, about 4 seconds	No. 2
:26 $\frac{1}{4}$	Sought fragments for nest No. 3	
:27	Aerated nest No. 1, about 10 seconds	No. 1
:27 $\frac{1}{4}$	Pursued female	

Ordinarily the aeration of the nests would be strictly alternated, but during the above fragment of observation the first three aerating activities were all in nest Number One. The second of these should have been in nest Number Two to maintain the normal activity. It is noteworthy that the schedule was nevertheless maintained, giving the impression that an activity rhythm had been set up that was not disrupted by calling at the wrong nest hole on one occasion. Such uncorrected "mistakes" have their counterpart in human activity where habit formation is involved in repeated and similar operations. Numerous other similar incidents were noted.

By way of further emphasizing the incessant activity that the male sticklebacks take upon themselves, various statistical measurements that were made at the time of observations may be briefly mentioned. For example, in 116 records of fishes with one to four nests, it was found that any one nest was aerated at intervals

of 10 seconds to 6 minutes and 15 seconds. The average time between visits was found to be 48 seconds, or a little less than one minute; less with one nest and more with four. The average time actually spent aerating a nest, on 89 observations, was found to be 6.3 seconds, with extremes of 3.0 seconds to 12.8 seconds.

The number of speeded up respirations during these times of active pumping of water over the eggs averaged 17 and showed extremes from 4 to 35 per period of respiration on a basis of 88 observations. Thus we have a pumping activity of roughly a little more than two cycles per second. The figures of the above tabulation are not strictly comparable, as they were of necessity made at different times. They may serve, however, to give a measure of the extreme activity of these fish, especially when the other alternating items that can not be as readily treated statistically are taken into consideration.

Although these fishes resort to our brackish swamps for breeding purposes, in an aquarium they thrive well in fresh water. The accompanying photographs were taken in the laboratory in standing water that was practically fresh. While this was in progress, others on public exhibition were nesting equally well in water from the New York City drinking supply.



More Room for the Bears

The Spectacled Species from the Andes Will Go on Exhibition in a New Den Sometime in April

RAYMOND L. DITMARS

SOMETIME in April, if all goes well, a new bear den in the Zoological Park will be ready for occupancy and our two spectacled bears will be put on exhibition. Their peculiar facial markings make them interesting additions to the varied collection already on exhibition and only a lack of room for proper and safe display has kept them in seclusion in the Hospital since their arrival two years ago.

Natives of the high Andes, hitherto considered difficult to keep alive in captivity, the spectacled bears have thrived since they arrived as cubs, the gift of an American engineer, A. M. Tweedy, on July 17, 1934. The species never attains any considerable size, as bears go, and in the past two years our specimens have attained a fair amount of their full growth.

With ten kinds of bears on exhibition at the present time, the Park may be said to have a fairly representative, although far from complete, collection, for the bear family, *Ursidae*, is much more extensive than is commonly known. Its distribution, too, is rather strange.

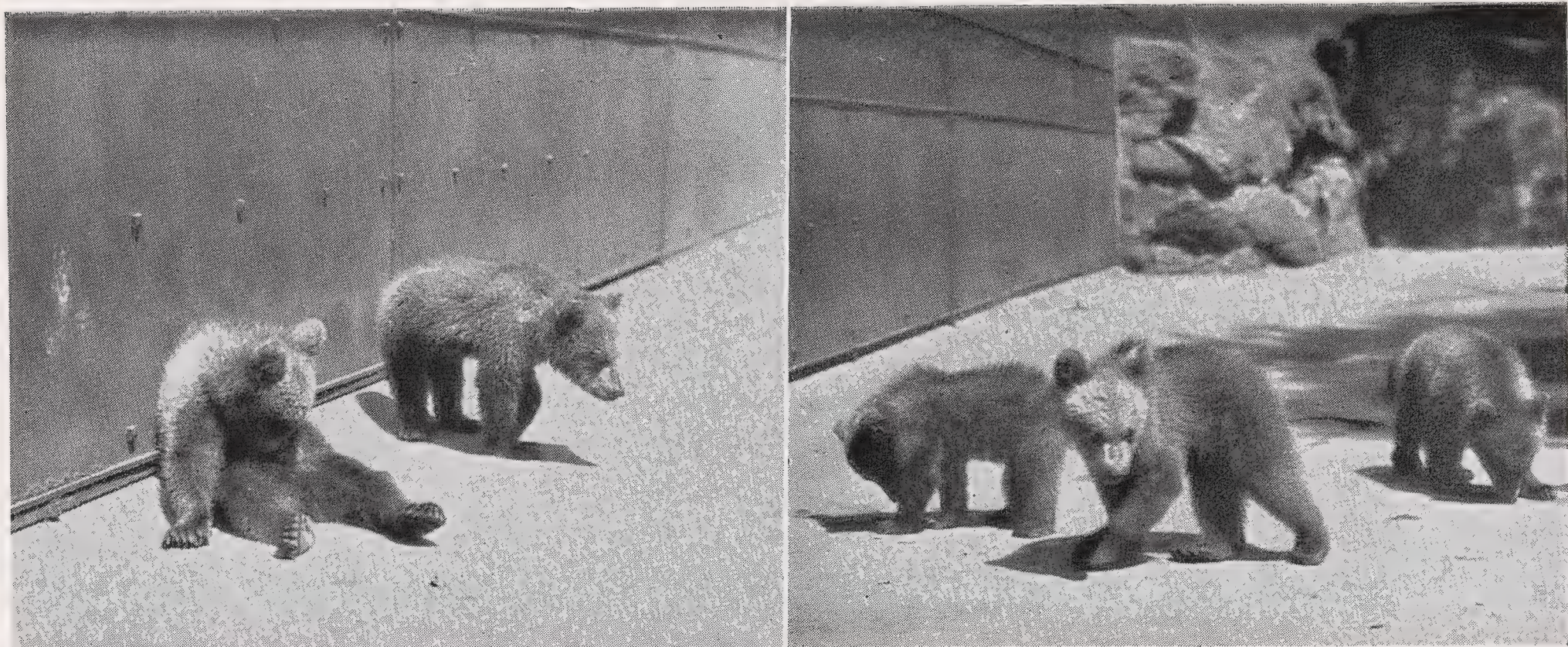
There are about two dozen recognized species in North America and another dozen in the Old World. The concentration of the latter is in Asia, but as a family the bears are largely confined to the temperate and colder latitudes of the northern hemisphere. A small species—the spectacled bear—does occur in South America, in the mountains of Peru and Colombia, but Africa has no bears at all with the exception of the European brown bear occurring north of the Atlas Mountains. There are but two tropical species, both in the Indo-Malayan area, and only one of these extends into the larger islands.

The bears inhabiting the northwestern part of North America are by far the largest of the world's carnivorous animals.

With this aggregation of spectacular types to draw from, the Zoological Park has always maintained an impressive series. The intention to do so entered into the original planning of the Park, as is evidenced by the series of bear enclosures, built against the side of a natural granite ledge and extending several hundred



The Russian brown bear keeps a watchful eye on her cubs.

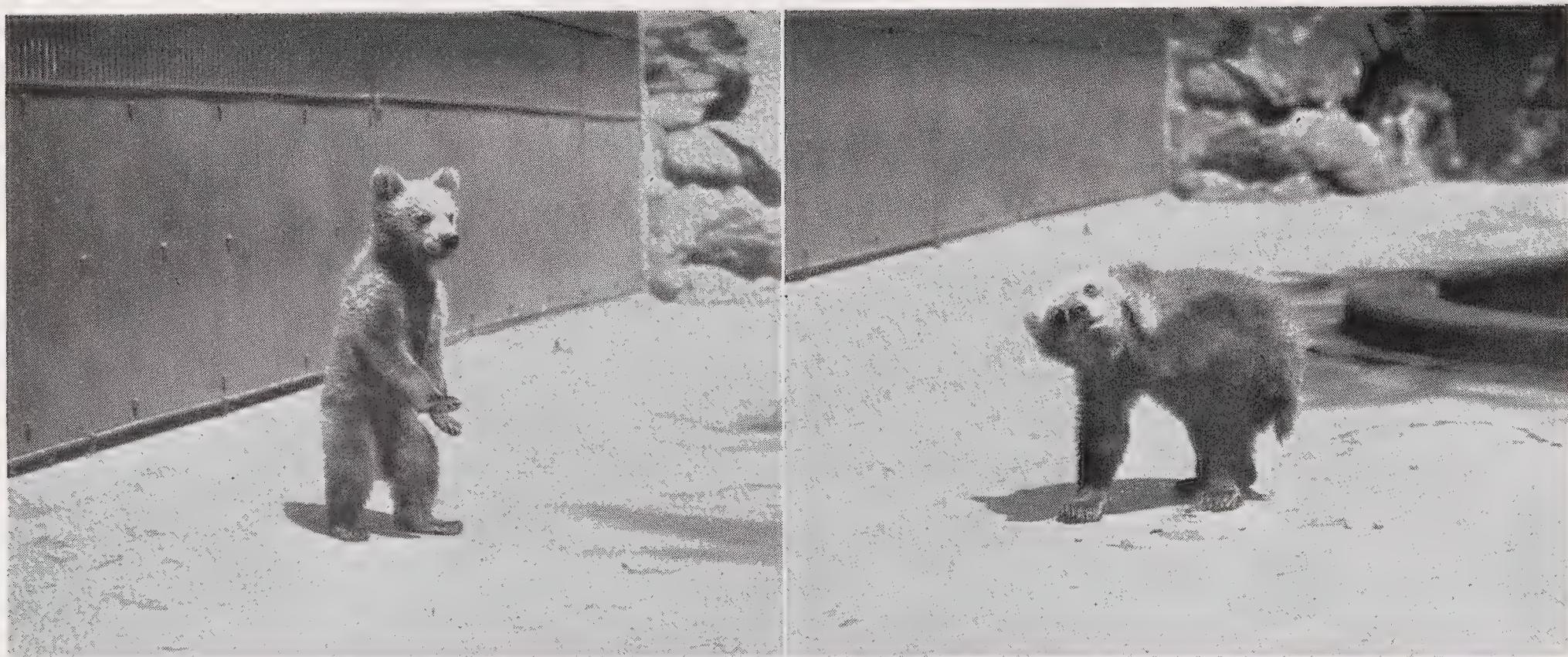


Cubs are always among the most attractive of zoological exhibits.

feet. These dens are very complete, having enclosed sleeping quarters at the rear and deep bathing pools in each. The average number of bears maintained in the dens has been slightly in excess of twenty. The greatest number ever exhibited at one time was forty-two specimens, representing fifteen species. During the more than thirty-five years since the opening of the Park, a number of our bears that were received when fully grown and of undetermined age have lived out long lives and peacefully died. Others, received when young, have developed to great size for their kinds and reached an age of twenty-five years or more. Several lived considerably more than thirty years and these periods of longevity appear to indicate the full

life spans of bears, excluding a few exceptional individuals. With us the larger species live longest, as indicated by our experiences with polar bears and Alaskan bears.

Among the notable bears exhibited in the Park were "Silver King," a polar bear lassoed on the Arctic ice and presented by Paul J. Rainey. This bear was full grown when received—in fact it was of exceptionally large size — and lived for twenty years. "Silver Queen," another full-grown specimen received at the same time, from the same source, is still on exhibition and in fine condition, more than twenty-six years after capture. Two hairy-eared bears from western Asia, full grown when received in 1901, lived respectively twenty-seven



"By early May they are able to leave the den in ambling play."

and thirty-three years. "Admiral," an Alaskan brown bear, received when a cub in 1901, grew to impressive size and died twenty-eight years later. "Ivan," an Alaskan brown bear, received in 1903 as a cub, attained an estimated weight of 1,200 pounds and died twenty-one years after arrival. A Kadiak bear, "Bella," lived from 1899 to 1922. Two records of grizzly bears are 1899-1923 and 1904-1935, respectively. Of the smaller bears our records show several in excess of twenty years, these including observations of a Mexican black bear and a Syrian bear.

A number of young bears have been bred and reared at the Park and a number of young have been destroyed by their parents. Our most successful breeding in the collection has been with the European brown bear, *Ursus arctos arctos*, and the Syrian Bear, *Ursus arctos syriacus*. The litters have varied in number of cubs from two

to three. The young have been born in February or early March while the mother was hibernating or during partial hibernation, making occasional appearances in the outside den but eating little. The young are relatively small and quite helpless and hairless, the eyes remaining closed for a considerable time. They are at first dependent upon the almost constant presence of the mother, as lacking the warmth of her body they are quickly chilled. By early May they are able to leave the den in ambling play and are among the most attractive of zoological exhibits. From our observations it would appear that bears require a fair period of years to reach really large size for their respective kinds. Growth for the first three years is pronounced and may reach sixty percent. or two-thirds the ultimate size. In that time they may even approach maturity, as regards breeding



The white circles around the eyes of the spectacled bear give him an unusual appearance that always demands attention. Sometimes the markings are more pronounced, as in this specimen exhibited in the Zoological Park a few years ago.

age, after which a slow increase in development may extend through an additional period of five years or more.

As it appears to be the usual habit of wild bears of the northern latitudes to hibernate during severe winters, it is of interest to note how this inclination affects captive specimens—the polar bear excepted. During mild winters we have seen the greater number of our bears active and roaming their outside dens and have made it a daily practice to feed them, although as a rule they eat rather sparingly. During such winters there may be sharp, cold spells and the bears will retire to the sleeping dens for a few days. The Alaskan bears are more inclined to remain outside.

During the prolonged and severe cold of the past winter, there were times when not a bear—except the polars—were to be seen outside. The snow in several of the dens, week after week, had not a foot-mark. The Alaskan bears would occasionally wander outside the sleeping dens, but the writer in making his daily inspection among the animals during the memorable cold of early February, passed the long series of upper bear dens on a number of occasions when not an animal was to be seen.

While bears are classified among the carnivorous animals and the greater number of the larger species prefer flesh to other foods, all kinds are omnivorous to a certain extent when wild and some of them largely so. The attacks of grizzly bears upon stock animals and their serious depredations in the past, when they were common enough, are well known. The habits of the big brown bears of Alaska are similar, with an added relish for fish and an adroitness in catching salmon when such delectable food is making its way up the rivers during the annual spawning periods. Wild bears dig small mammals from their burrows, but they as frequently dig for succulent roots and also feed upon various berries. The food provided for our series of bears includes bread in large quantities, stale loaves that have become misshapen in baking and could not be sold through the regular bakery channels. We also feed considerable quantities of parboiled beef, raw fish and raw vegetables. The bread, however, forms a generous and staple part of the diet of all the bears, large and small.

The mentality of bears differs markedly from that of other large carnivorous animals. From their attitude toward the human, when they are in captivity, the average wild bear can not be rated as a dangerous type—certain individual grizzlies and Alaskan brown bears excepted. In routine of their cleaning work our keepers enter the dens of all the bears except the polars. The latter stand out as quite uniformly hostile to familiarity and inclined to attack in a moment. This is not the case with the great bears of the Alaskan mainland and Kadiak Island, the grizzlies, American black and brown bears, nor the larger bears of Europe and Asia. The men carry hickory sticks into the dens and keep them within instant reach, but an occasional disciplinary gesture with one of these weapons usually causes the bears to climb to the upper levels of the ledges and rather indifferently gaze down on the cleaning process, which includes the operation of hose and broom. Occasional eccentric specimens, particularly among examples of the small Japanese bear and the Malayan sun bear, are bad tempered. Small individual dens, which it is not necessary for the men to enter, are provided for such specimens.

Another point about the mentality of bears is their keen intelligence. Owing to their strength and agility and the inclination of an escaped bear to start on a rapid journey of exploration and to resent interference, these animals are particularly dangerous to transfer, in shifting cages, from one enclosure to another. Great caution is also necessary in releasing newly-arrived bears from traveling cages. The animals keenly watch everything that is going on and may note a slight rocking of a cage on an unsteady platform or some narrow opening between the traveling cage and framework or door of the den. The latter condition is particularly dangerous, as a forelimb may be thrust through and a heave of a powerful shoulder thrust the cage aside. We have found that it is precarious to use ropes to bind a traveling or shifting cage to a den. Such a lashing is safe enough in transferring a lion or tiger, but with the ingenuity and concentration of a bear upon a weak spot, there is always a possibility that a cage may be shifted within rope lashings.

For such handling of bears we have long iron rods with terminal hooks that go over the den

bars and extend to the back of the cage. These rods are broadly threaded. A metal plate is placed across the back of the cage. It is bored at each end to admit the bars and wing nuts are attached to the bars and run up tight against the plate. Thus the cage is as firmly pulled against the metal structure of the den, as if it were a part of it.

Further evidence of the keen mentality of bears has been shown among our specimens by some of them retiring to their sleeping quarters in inclement weather and deliberately closing the rolling steel panel behind them. A Syrian bear thus systematically always shut himself in. An Alaskan bear would do so occasionally, hooking his claws over the edge of the door and

closing it with a slam. Circus men have told the author they have noted similar actions among bears in their charge, in closing sliding ventilator panels on the wagon cages when the panel sides were up for traveling.

The greater number of our bears are in dens open at the top, but with a border of bars bent inward in crescentic form. Such construction is insufficient for the Indian sloth bear, the Indo-Malayan sun bear or the Andean spectacled bear. The latter two, particularly, can climb almost with the agility of monkeys. For such types there are special dens with bars completely spanning the tops but fully open to the sun and air, which are requisites in the successful maintenance of a collection of bears.



Silver King took not at all kindly to the process of being roped and dragged aboard the Arctic vessel which brought him back to New York. Several times he braced himself against the side of the launch and attempted to climb aboard.

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A Fatal Bite

What was apparently a case of a snake dying from the effects of the venom of another snake of the same genus, although of a different species, occurred in the Reptile House this winter.

Some weeks ago we received a considerable shipment of snakes from South Africa, brought to us through the courtesy of A. M. Vida, the radio operator of the American-South African liner *City of New York*. Among them were two African yellow cobras, *Naja nivea*.

No other cases being available, the two newcomers were ordered quartered in a case already containing several specimens of the Indian cobra, *Naja naja*. Both species have, in the past, occupied the same cage and have lived together in perfect amity.

This time there was trouble. At the jarring of the door in the back of the cage being opened, one of the Indian cobras reared inquisitively and expanded its hood. The snake stood watching as first one and then the other of the African species was introduced on the end of the snake hook.

The second African cobra was scarcely in the case before it reared and in a lightning-like stroke bit the Indian cobra in the neck, just where the hood begins to expand.

I was watching the snakes from the exhibition side of the cage and stood by to see what effect, if any, the bite would have.

The results were not long in appearing. Within five minutes there was a swelling on the Indian cobra's neck the size of the end of one's finger. Within a few hours it was considerably reduced and hardly noticeable, but a few days later the swelling recommenced and within one week extended down the snake's side for eighteen inches, in the form of a puffy series of lumps. A week later the snake was dead.

No autopsy was performed at the Park, as the specimen was wanted at the American Museum of Natural History for its series of preserved specimens, but inasmuch as the bite was not in a vital spot, there can be little doubt that the action of the venom of *Naja nivea* was responsible for the death of *Naja naja*.—R.L.D.

Another Pigmy Hippo

The birth of a pigmy hippopotamus in the Zoological Park is no longer the exciting event it was some seventeen years ago when the first 9½-lb. infant arrived two days before Christmas and for twenty-four hours virtually halted all routine while heroic and unsuccessful efforts were made to induce it to take nourishment.

For a time it seemed that the birth of a pigmy hippo was to be a fixed biennial event and up to 1929 five babies were born. Then the "custom" lapsed and it was not until January 16 of this year that another baby arrived, this time an offspring of one of the earlier arrivals—thus the second generation to be born in the Park.

Although the state of the baby's health for the first few days caused some anxiety and demanded night attendance on the part of the veterinarian and Keeper Richards, it gained health and vigor rapidly and in less than a week was on a regular feeding schedule.

The father of the new baby is "Jumbo," the young male acquired in the shipment of three received in the Park on July 9, 1912. The story of those first three pigmies has already been told in the Society's publications, particularly in the BULLETIN for July, 1912, and the Annual Report for the same year. It will be recalled that Carl Hagenbeck commissioned Hans Schomburgk to go into Liberia and bring out live specimens of an animal that was little more

than a myth. Dr. Samuel G. Morton of the Philadelphia Academy of Sciences had described it in 1844 from incomplete skulls sent him from Monrovia by a friend. A living specimen had actually been shipped out of Africa to the Dublin Zoological Gardens, but it arrived in a dying condition and was said to have lived "only about five minutes," so that it was never actually on exhibition.

After innumerable difficulties and discouragements, Schomburgk managed to capture five of the animals, three of which came to New York. They were a young pair and an adult male and all three were in excellent condition and eating regularly.

As the first healthy examples to be offered for exhibition, they attracted a vast amount of interest and certainly justified the large price of \$15,000 paid for them—a sum, incidentally, that was not incommensurate with the costly ex-

peditions that Schomburgk made for Hagenbeck.

"Jumbo" and "Tieda," Hagenbeck had named the young pair, and the adult male bore the name of "Heinie." In 1925 he was disposed of to a London animal dealer, but the original pair still remain in the Park.

Two of their offspring died within a short period after birth. One was sold to a New York dealer, one was presented to the London Zoological Society on the occasion of its centenary in 1929, and another, the mother of the new baby, is still in the collection here.

In view of Schomburgk's statement that in Liberia the young are born in the beginning of the dry season, or in November or December, it is interesting to note the dates of the six births recorded in the Park: December 23, 1919; January 23, 1921; March 24, 1923; December 9, 1925; February 1, 1929; January 16, 1936.

—W. B.



The new pigmy hippopotamus, although still on a milk diet, explores with its mother the possibilities of vegetables. The baby has no difficulty in waddling around its quarters in one end of the Elephant House and appears to be growing rapidly.

Alice Takes a Walk

Alice, the 42-year-old Indian elephant that has been the queen of the Zoological Park's Elephant House since 1908, took a walk through the Park at daybreak on February 4 and, not liking the cold outdoors, pushed her way back into the house and was found peacefully warming herself in the steam-heated interior when the keepers came on duty at 7 A.M.

Some time during the night previous to her walkout the sewer draining Alice's stall became clogged and ice-cold water backed up to a depth of several inches. Uncomfortable and alarmed by the rising water, Alice sought a way out. The door leading to her exercise yard was locked and bolted but Alice manipulated the bolts with the tip of her trunk and butted her way out.

The external gates from the exercise pen into the Park were closed, but Alice pushed through them and gained complete liberty. It was probably around 5 A.M. when she walked out. Twenty-five years ago when Alice was a comparatively young elephant she had been accustomed to making a daily visit to the Cook

House in the service yard for a treat of stale bread and she remembered her pleasures—and the exact route—after a quarter of a century.

She tramped through the snow to the Cook House, robbed the bread basket, explored the fascinating recesses of a waste box and then started back to the Elephant House, stopping along the way to overturn several waste paper cans.

The gates and doors through which she had pushed her way out had closed behind her and Alice was impatient. She shoved through the central glass and framework doors, by which the public enters the house, and thus regained the interior.

One of Alice's early exploits was to break into the Reptile House and smash most of the cages. Apparently she still delighted in the sound of crashing glass, for she broke several of the glass panels in front of the cages in the Elephant House, after she returned.

Keeper Richards found her quiet and contented when he came on duty and as soon as another, and dry, stall was prepared for her, she was led unprotestingly into it.—W. B.



It has been many years since the Bronx River ran as full through the Zoological Park as it did early in March. Water roared over the falls below the Boathouse Restaurant. Normally the tree near the center of the picture is on dry land.

PUBLICATIONS

Free to Members:

Bulletin: The official publication of the New York Zoological Society reports bi-monthly on interesting phases of work at the Park and the Aquarium and contains articles on natural history in a sound yet popular form, with many illustrations. Thirty-eight volumes have been completed.

Zoologica: Scientific contributions of the New York Zoological Society. Volumes I-XIX are complete, and other volumes are in preparation. *Zoologica* is illustrated, and is published as material is presented. It is sent to Members on request.

Zoopathologica: Scientific contributions of the New York Zoological Society on the diseases of animals. Volume I and II are completed. It is illustrated, appears when material is available, and is sent to Members on request.

Annual Report: Documents, reports and pictures of the work of the various departments of the Park and the Aquarium. As a rule it contains articles of scientific value and considerable general interest.

Gallery of Wild Animal Paintings in the Zoological Park: A handsomely illustrated catalogue of the gallery in the Administration Building at the Park, which Members may receive on request.

Some Books by Members of the Park Staff:

Beebe: HALF MILE DOWN. 344 pages, 123 illustrations and 8 colored plates. 1934. \$5.

An account of the deep-sea explorations of the Department of Tropical Research in the bathysphere.

Blair: IN THE ZOO. 195 pages, 55 illustrations. 1929. \$2.50.

Entertaining and informative animal stories drawn from long experience in the Zoological Park.

Crandall: PARADISE QUEST. 226 pages, 52 illustrations. 1931. \$3.50.

A vivid description of a successful expedition to New Guinea in search of Birds of Paradise for the Park collection.

.....: PETS AND HOW TO CARE FOR THEM. 296 pages, 96 illustrations. 1930. \$2.

A practical manual for everyone who keeps animal or bird pets.

Ditmars: CONFESSIONS OF A SCIENTIST. 241 pages, 39 illustrations. 1934. \$3.50.

Adventures in collecting and maintaining animals in the Zoological Park.

.....: SNAKES OF THE WORLD. 207 pages, 84 pages of illustrations. 1931. \$5.

A comprehensive book of reference on the snakes of the world.

Leister: PRESENT DAY MAMMALS. 74 pages, 106 illustrations. 1931. \$1.

A valuable classification and reference book for schools and students of zoology.

All these books and others by the same authors may be obtained from the New York Zoological Park. For book express add 15 cents postage for each volume.

A classified list of the publications of the Society, with subject headings of articles printed in the *Report*, *Zoologica* and *Zoopathologica*, as well as reprints from them, will be furnished on request. Some of the publications have become exhausted and orders for any issues will be governed by this circumstance. Orders for any of the publications should be addressed to H. R. MITCHELL, *Manager, Zoological Park*, 185th street and Southern Boulevard, New York City.

No effort will be spared to ensure delivery of the regular publications to Members of the Society, but changes of address, forwarding points and non-delivery of mail should be reported promptly. Back numbers of *Bulletin* still in print will be supplied to Members and others at the rate of 30 cents each. Postage and handling, 5 cents extra.

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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

Annual Membership in the Society is \$10, renewable annually. Life Membership may be obtained for \$200. A contributor of \$1,000 becomes a Patron; \$2,500 an Associate Founder; \$5,000 a Founder; \$10,000 a Founder in Perpetuity, and \$25,000 a Benefactor.

All classes of Members are entitled to receive every periodical publication, the privileges of the Administration Building with its lounges and reception rooms and gallery of paintings of animals, to attend lectures, open meetings and entertainments, and to be admitted free to the Zoological Park and the Aquarium every day in the year.

Application for Membership may be given to the Director of the Zoological

Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 101 Park Avenue, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



**PRINCE RUDOLPH'S BLUE BIRD OF PARADISE
IN FULL DISPLAY**

One of a series of watercolor sketches by Paul Bransom,
now in the art collection of the New
York Zoological Society

BULLETIN

NEW YORK ZOOLOGICAL SOCIETY

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Vol. XXXIX

May-June, 1936

No. 3

Birds of Paradise In Display

Now the Theory of Courtship Posturing Is Disputed by a Belief That
It Is Partly a Warning to Rival Males

LEE S. CRANDALL

IT was in 1910 that the Zoological Society received three Greater Birds of Paradise, probably the first of this group to be seen alive in America. During the following years others were shown sporadically but it was not until 1928 that a more extensive collection was determined upon. In that year, the Society dispatched an expedition to New Guinea, which returned, after an absence of seven months, with forty birds of paradise, representing nine species. With these birds as a nucleus, the collection has been extended, through purchase, to really impressive dimensions.

Millions of visitors have seen these birds, thousands have seen the males in display. From a purely aesthetic viewpoint, our efforts have been amply repaid. But our birds of paradise have yielded more than this. For they are of special interest not only for their beauty but for their curious, little known habits. The difficulties of field observation have kept their ways obscure. In the course of time, we have been able to make some small contributions to knowledge of the group, beginning with the description of the display of Prince Rudolph's Blue Bird of Paradise (*Paradisornis rudolphi*), published in the BULLETIN for September, 1921. In ZOOLOGICA, Volume XI, Number 7, 1932, a number of others were added, including the Long-tailed (*Epimachus meyeri meyeri*), the Emperor of Germany's (*Paradisaea guillemi*)

and Lord Rothschild's Gorgetted (*Astrapia rothschildi*). But the printed word can never convey a true picture of a bird of paradise in display. Even the birds' appearance in repose is not well understood, a condition which we hope has been somewhat remedied by the excellent series of photographs appearing in the BULLETIN for September-October, 1935. With the photographs appearing in this issue, augmented by Mr. Bransom's delightful color sketch of the Blue, we feel our efforts to place the birds of paradise on a more familiar basis have reached a climax. Since the credit for obtaining these pictures belongs entirely to Mr. Bridges, who designed the apparatus, and to Mr. Osterndorff, the photographer, there is no reason why I should not express my feeling that they are exceptionally good. And this occasion must not be passed without paying due respect to Samuel Stacey, Head Keeper, whose unequalled skill in the care of birds has reached new heights since our collection of birds of paradise was founded.

Now, having introduced our pictures with what I feel is restrained praise, perhaps we may venture to speculate somewhat on the nature of the actions they represent. Not so many years ago, we should have called them "courtship displays" and anticipated no unhappy result. Nowadays, however, the cautious writer may consider it safer to omit the definitive, for

long-standing theories concerning this particular phase of bird life are in the throes of revision. Darwin thought that the spring-time gyrations of male birds were undertaken purely for the delight of the females, each of which was supposed, in her own good time, to choose the most brilliantly colored or agile of the available suitors, thus insuring the continuation of whatever charms he might possess. This theory, revolutionary though it may have been in 1859, is no longer acceptable to most naturalists, who question the ability of the female to exercise the delicate discrimination implied. This feeling of doubt has been so long continued that many have come to wonder if male displays really have any direct relation to courtship; a recent suggestion that their primary purpose may be simply a warning to rival males has aroused much interest. Support for this theory is found in so ready a subject as the common street sparrow, whose rowdy spring-time antics are familiar to everyone. The spread tail, drooping wings and expanded body plumage are as likely to presage a noisy attack upon a fellow suitor as a hardly less boisterous demonstration before the beleaguered female, who herself may very well enter the general *mêlée* before it is finished. The great mating season sham battles of the European Ruff, and the more sanguinary combats of the Prairie Chicken, add further weight to the argument. Countless others could be brought to mind, demonstrating the similarity between combat and courtship attitudes.

Moreover, there is the apparent reaction of many watching females to be considered. One of the most remarkable displays is that of the peacock. The adult bird selects a favorable spot for his manoeuvres, which he guards jealously from the inroads of other males. Here he may be found on any sunny spring day, spreading his gorgeous train for all to see. But what of the peahen? She may be seen wandering casually nearby, seeking insects in the grass, usually with her back turned to the entrancing male. Her indifference appears to be complete and seems to offer sound evidence against the persuasive qualities of the cock's display, until close observation shows that she is merely acting a part and rather overdoing it. Her diligent hunting for invisible food is too obviously a

sham, her attitude of indifference too studied. And then, if she cares so little, what is she doing there at all? This is the cock's place. She has the world, decently limited, to roam at will. But no, only this place will do. The answer is too plain. She does care—very much indeed. It is the mating season, and she has no power to resist the lure of that dazzling fan, which has beckoned to peahens for so many generations that it has taken a fundamental place in the breeding cycle. She feigns indifference because that, too, has become part of the game. Each day she comes, picks at her imaginary insects, peeks shyly at the marvel, and goes her way. Each day the dance of the male becomes more fantastic: he runs a few steps forward, then backward, sometimes rattling the quills of wings and train with a sound of wind through canebrakes. And in due time the white eggs are laid, peachicks emerge and the race goes on.

It would seem, then, that it may still be possible to write "courtship" before "display." We cannot avoid the basic principal of the attraction of male beauty for the female. Development of mating attitudes may have caused a spread into other activities and the most important result is surely to be found in fighting. But if we adopt the suggestion that this similarity may be due to a single reaction to the sex impulse, on which male rivalry is largely based, we overcome the most serious obstacle.

If we admit that male displays are primarily for the attraction of the female, then we must also admit that they serve the purpose, for otherwise they would be futile. It follows, then, that the female must be deeply moved and stimulated by the display, each according to the species habit developed through countless generations. If this is true, and I feel that it is, then when it is done to perfection, so much greater must be the female's reaction. So now we come again to Darwin's theory of Sexual Selection—with a twist. For instead of carefully selecting the male that strikes her as the handsomest, it seems to me that the female acts from an irresistible impulse to accept the one that approaches most nearly the highest standard of her race. Thus would the chief principal of Darwin's thought be supported: the finest males, as well as the most vigorous, would be certain of finding mates, and the species would continue in all its glory.

BIRDS OF PARADISE IN DISPLAY

Fourteen Photographs Taken in the New York Zoological Park

The display postures of the birds of paradise have a definite, routine form which may be divided into two or more stages, the last one being the climax or full display when the beauty of "the most beautiful birds in the world" is revealed for a few seconds in unsurpassed grace and harmony of line and color. The photographs that follow were selected from a collection of more than twice the number, taken during 1935 and 1936, to illustrate the display stages of several of the birds as completely as possible. Only six of the sixteen forms of the birds of paradise now in the Zoological Park collection are here represented and not all of the display stages are pictured in each case. This double incompleteness derives from the fact that the males of some forms are lacking in the collection, that some birds steadfastly refused to display when placed in a glass-fronted cage before the camera, and that others displayed so infrequently that one, or at most two, photographs were all that could be obtained during weeks of waiting and watching. No comparable photographs have ever before been taken of the birds of paradise in display and, consequently, those reproduced on the succeeding pages may be said to break new ground.



GREATER BIRD OF PARADISE

Paradisaea apoda apoda Linnaeus.

FIRST STAGE

The Greater is the "typical" Bird of Paradise—best known to the public because its golden plumes were worn as hat ornaments until their importation was stopped by law. Its body and wings are chocolate-colored, its throat emerald, and its filmy plumes a full, bright gold. Initiating its display by three or four piercing and raucous calls, the bird then spreads its wings and raises its plumes, while facing partly sideways in anticipation of the secondary stage, or climax.



GREATER BIRD OF PARADISE

FULL DISPLAY

Having only two stages in its display, the Greater quickly reaches its climax by assuming the position shown here, with its body parallel to the perch. At this point the plumes and wings are spread to their fullest extent and the bird sometimes hops with a jerky, stiff-legged motion along the limb while uttering a peculiar "display call" in short, twanging notes.



LESSER BIRD OF PARADISE

Paradisaea minor minor Shaw.

FIRST STAGE

At first glance the Lesser is simply a slightly smaller specimen of the Greater Bird of Paradise, which it resembles strongly in color except that its plumes are tipped with white instead of brown and its back is golden. The plumes of the Lesser, too, are fuller and softer than those of the Greater. Their display forms are closely similar and begin in the same manner.



LESSER BIRD OF PARADISE

FIRST STAGE, REAR VIEW

"A cascade of gold" is actually a prosaic description of the plumes of the Lesser in display. Perched fully upright, its body and wings rigid, the bird may make a few quick and short motions of its wings, at the same time issuing its loud and abrupt calls, before going into the second and final stage of its display. The plumes appear to be slightly heavier than those of the Greater.



LESSER BIRD OF PARADISE

FULL DISPLAY

Sometimes the Lesser varies the procedure of its full display by holding its wings stiffly horizontal instead of curving them downward as shields for the body, as the Greater almost invariably does. This bird displayed many times while attempts were being made to photograph it, but not once would it bring its wings into the final, downward position which it had often previously been seen to assume when it was in another cage to which it was more accustomed.



COUNT SALVADORI'S BIRD OF PARADISE

FIRST STAGE

Paradisaea apoda salvadorii Mayr & Rand.

Violent action, to the point of frenzy, is characteristic of Count Salvadori's Bird of Paradise at the beginning of its display. Without warning the bird begins a rapid series of loud calls, at the same time running along its perch and whirling its dark red plumes over its back in a flickering, smoky cloud. So swift are its motions that even an extremely fast exposure failed to make this photograph sharp and distinct. Nevertheless, it presents an accurate impression.



COUNT SALVADORI'S BIRD OF PARADISE

SECOND STAGE

After running for several feet along its perch, the bird quenches the sudden fire of its display. Then quickly reversing itself, it hops stiff-legged along the limb with its plumes spread above its back more sedately and orderly. It is a curious fact, here recorded for the first time, that at this stage of display the radius and ulna in the wings are compressed against the humerus, causing a foreshortening that has not been noted in any other bird of paradise during display.



COUNT SALVADORI'S BIRD OF PARADISE

THIRD STAGE

As the display approaches its climax, the glowing red plumes are high-arched and the bird spreads its wings widely, holding its body rigidly horizontal. Even this late in the display, it continues to hop slowly along the perch, although with far less abandon than in the fury of its first attack or the lovely dignity of the second stage.



COUNT SALVADORI'S BIRD OF PARADISE

FULL DISPLA

At the climax, the bird abruptly tilts forward until its body is almost perpendicular. For several seconds it remains immobile with wings full-spread and its rather stiff plumes upright. Then it draws up and begins the display all over again with undiminished frenzy.



EMPEROR OF GERMANY'S BIRD OF PARADISE

FIRST STAGE

Paradisaea guilelmi Cabanis.

Only two of the plumed Birds of Paradise, the Emperor of Germany's and Prince Rudolph's Blue, are known to have an upside-down display. The former begins by holding its body almost horizontal and jumping rapidly from one perch to another, opening and closing its wings.



EMPEROR OF GERMANY'S BIRD OF PARADISE

SECOND STAGE

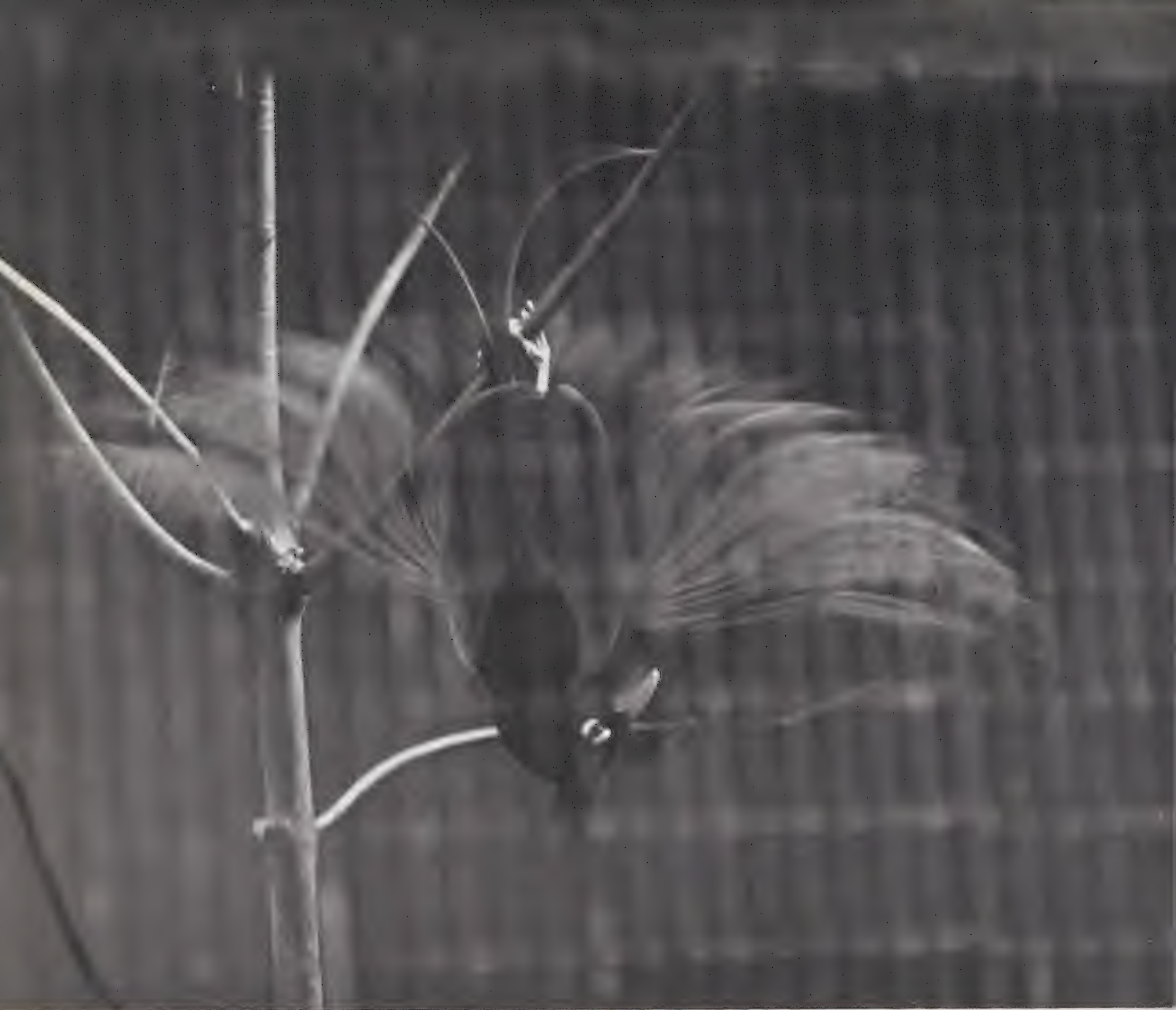
Suddenly going over and hanging suspended from its perch, the bird almost immediately begins to spread its plumes and draw its head and body tensely upward until they are almost horizontal under the limb. This picture caught it just after it had dropped down and before it had begun to pull itself into the semi-curved horizontal position.



EMPEROR OF GERMANY'S BIRD OF PARADISE

FULL DISPLAY

When its body is more or less parallel with the ground the bird spreads its plumes on either side in two broadly curved fans and then begins a slow, graceful weaving of its body in a flattened oval that causes the plumes to swirl and sway. Its motion was not fully arrested in this photograph, but the head and beak can be seen just above the white neck, at the lowest point of the half-circle formed by the wings. The plumes were in violent motion.



PRINCE RUDOLPH'S BLUE BIRD OF PARADISE

Paradisornis rudolphi rudolphi Finsch.

FULL DISPLAY, REAR VIEW

This photograph of Prince Rudolph's Blue Bird of Paradise in display was made several years ago before a glass-fronted cage was available and consequently it is marred by the shadowy outlines of the wire netting. The main features of the display are discernible, however. The bird's back is shown, with its head turned so far sideways that it almost appears to be facing front. At the beginning of display, it sits on its perch and calls, then slowly and cautiously lowers itself backward. When the whole body is pendant, the bird gives a vibrant shake that extends its plumes. As it gently rocks its body from the hips, it makes the plumes dance and flutter, and occasionally it gives a harder shake to extend them still further. The bird sings in a low, grating voice while displaying, in notes that almost seem to be a connected song.



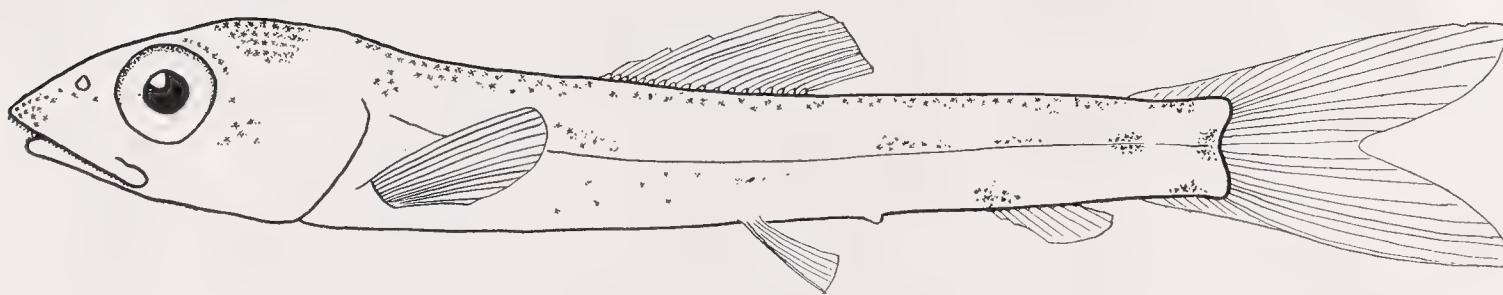
WALLACE'S STANDARD-WINGED BIRD OF PARADISE
Semioptera wallacii wallacii (Gray).

FULL DISPLAY

Perhaps the simplest of the bird of paradise displays, and the only one to which the word "clownish" can be attached, is that of Wallace's Standard-winged. The bird itself is not as spectacularly beautiful as most of the others. Its body color is chiefly gray, of an unexciting tone, although its drabness is relieved by a long, emerald-iridescent breast shield. Two thin and shaft-like feathers, the standards, with light gray tabs on the ends, extend from the shoulder of each wing. They are erectile and as the bird hops from one perch to another, sometimes upside-down or sideways, it throws its standards forward and vibrates them rapidly. It utters a thin but persistent note all during the display and is really noisy at that time.

A Fish Which Grows by Shrinking

GLORIA HOLLISTER



Drawing by George Swanson.

Bonefishes have the curious habit, in early life, of growing "down" instead of "up," until a certain minimum size has been reached. When this youngster had shrunk from 2 $\frac{1}{4}$ inches to about 1 inch, he was a perfect miniature edition of his three-foot parent.

THE bonefish, grubber or ladyfish, technically known as *Albula vulpes* (Linnaeus), ranks among the highest as a game fish.¹ The ladyfish surpasses its famous cousin, the Silver King, or tarpon, in possessing a combination of qualities, that of gaminess and of being a table delicacy. The bonefish can be caught from November to April but December is said to be the best month. The bonefish and the tarpon are two living representatives of an old group of fishes, most of whose members no longer exist in life.² Their common ancestor was probably an ancient herring-like fish.³

The bonefish lives in almost every tropical sea and sometimes is found wandering beyond what man has defined as the tropical zone. Fishermen, particularly in Bermuda, know this fish as the grubber because of its characteristic way of grubbing for its food in very shallow water. Here it noses out mollusks by digging with its prominent cone-shaped snout which overhangs the lower jaw. Often, while grubbing, these fish turn a complete somersault, their silver-scaled bodies flashing in the sunlight as their tails flip over. Once, on Nonsuch, we were

almost blinded while trying to count the scales of a grubber in the sunlight. This fish grows to a maximum size of about three feet, and the world's record is a 13 $\frac{3}{4}$ -lb. fish taken off Bimini in the Bahamas.⁴ The young, or larvae, are flattened and transparent and in this respect resemble eel larvae. In the young form the head is very small, the body elongate, and the tissues transparent. It looks not at all like the parent that it often takes hours to pull in on a hook and line.

Piecing together a complete life history from many different looking fishes is not only fascinating in itself but of value to ichthyological science. The growth stages of a certain fish change from a flat, transparent, leaf-like atom to an elongate, slender black deep-sea eel. Another startling example is the duck-billed fish, (*Idiacanthus fasciola*), with eyes poised on long stalks, which changes into a fish with close-set eyes and not unusual looking jaws.

Among the accumulation of data about fish there are comparatively few complete life histories tracing the gradual change with growth from egg to adult. This is due in part to the fact that only a small number of persons are studying the subject and also to the difficulty of collecting living specimens and observing them in their own medium. It is easy enough

¹ Heilner, Van Campen. In Southern Waters After Bonefish. *Natural History*, Jan. and Feb., 1928, Vol. XXVIII, No. 1, pp. 88-92.

² Cockerell, T.D.A. The Antiquity of *Albula*. *Copeia*, Dec., 1933, No. 4, p. 226.

³ Gill, Theodore. The Tarpon and Lady-Fish and Their Relatives. *Smithsonian Miscellaneous Collections* (Quarterly Issue), Vol. 48., May 13, 1905.

⁴ Breder, C. M., Jr. Field Book of Marine Fishes of the Atlantic Coast. 1929.



Painting by Else Bostelmann.

*It is a detective's game to work out the life histories of some fishes because of the extreme dissimilarity of their young and adult stages—for example, the great, black, deep-sea gulper eel, *Gastrostomus bairdii*. The four small fish are immature stages in the development of the large eel.*

to pull a fine silk net on the surface of the water behind a slow moving boat and get many fish eggs and larvae of known and unknown species. But the way to raise these little creatures until they grow into recognizable adults is a problem still unsolved. So the next best way is to assume the role of a detective and work out life histories in preserved specimens. It is a detective's game to take a mass of diverse looking fishes and, with only one or two known characters as clues, to recognize Dr. Jekyll and Mr. Hyde as the same individual with a superficial disguise to fool us. An amazing example is the big-headed (really a big mouth) black, deep-sea gulper eel, (*Gastrostomus bairdii*), which when young has a small head and a flat, white body. In its most youthful stage, when the eel looks quite unlike the adult, there is a clue in the ten tiny tail-lights which remain constant with growth, through all the intermediate phases and changes, to maturity. Then, there are certain pelagic larvae and young fish which possess curious structures that disappear altogether, and the larvae may be so different from the adults that they have been described as different fish; that is, different species and even genera.

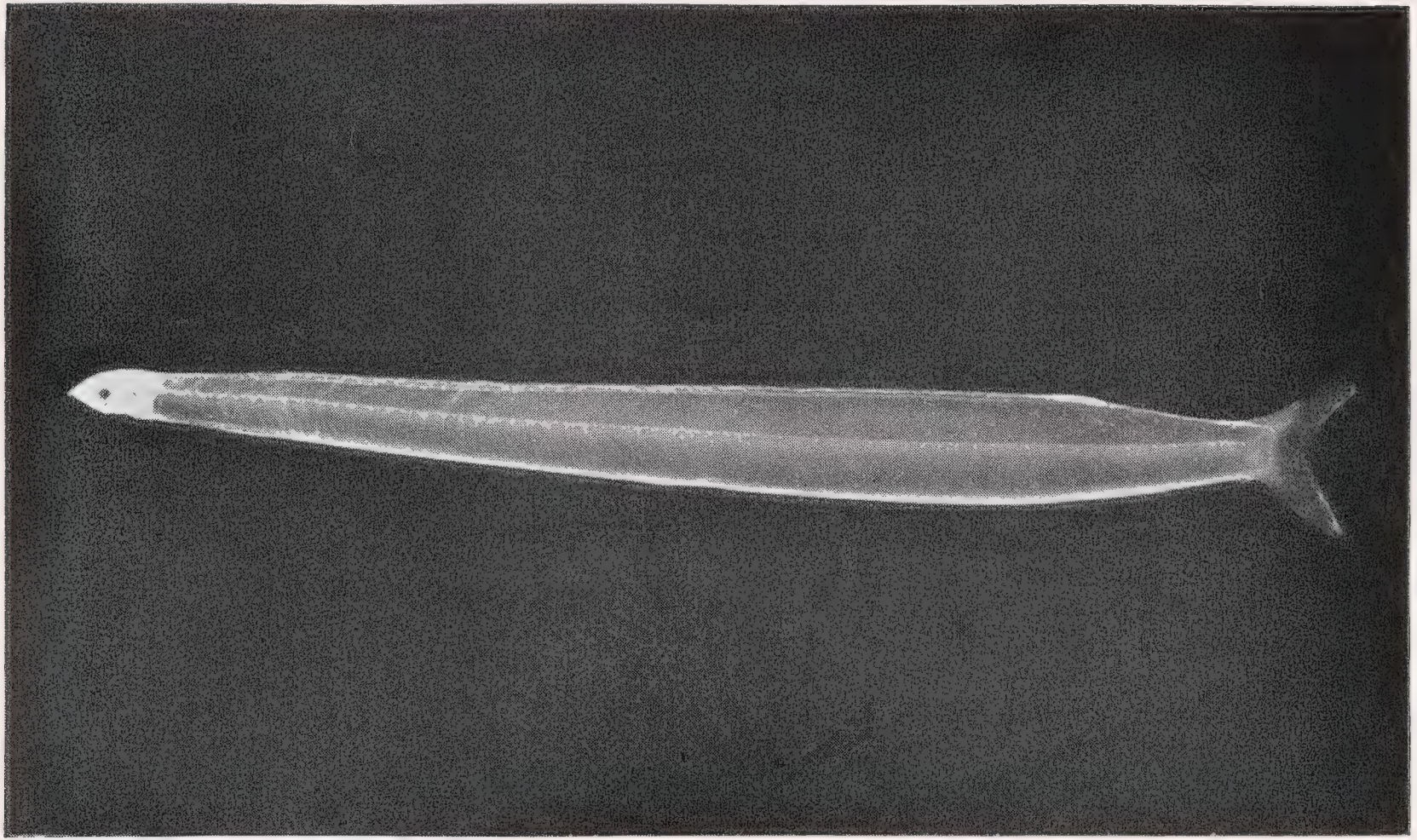
But, after tracing out a growth series in preserved specimens, there always remains the unanswerable question of how long did it take? Did this transformation take a day or a year? Trying to estimate the element of time in a series of preserved specimens is as elusive and intangible as the defining of the fourth dimension. In a few fishes, however, as the cod, the rate of growth can be correlated with time by the number of rings on the scales. Here the rings represent a certain period of time, dividing themselves into "summer belts" and "winter belts." The difference is seen very plainly, for during the summer there is more rapid growth and a broader belt is formed than during winter. But in certain fishes (silurids) scales are never developed and in some of the eels they remain hidden in the skin. So this method of estimating rapidity of development and age works, at present, in only a very few fishes.

The first observation of the growth and transformation in a single living fish made recently in Bermuda was all the more startling after repeated study of preserved specimens. In recalling this observation of last summer, which was purely accidental, I still look upon what

I watched and recorded as almost magic. On several days I asked members of the staff to check my observations and thereby prove that they were real and not imaginary. A big-game fisherman would have regarded my excitement as a sign of certain insanity had such a person been present during these ten days. The subject was a speck of life which looked like an animated strip of white tissue paper, two and one-quarter inches long.

This came about on one warm evening in the middle of August, 1935, when I was studying the fauna that was attracted evening after evening to the electric light which we lower over the edge of the wharf of the Department of Tropical Research station at New Nonsuch. On this particular moonless night a strong in-shore breeze was blowing and the water of the bay was slopping against the wharf. It was a poor night for night-light observing but I was interested to see if the same familiar visitors would be attracted as on calm evenings. The electric bulb had to be kept dry and because of the roughness of the water it was impossible to lower the light to its usual position just above the surface. This condition, along with the high tide and the roughened surface, prevented the usual penetration of the light to the bottom about five feet below. The surface visitors came just the same and kept me occupied and fascinated for several hours. What approached below the surface I had no way of telling, but the surprises that came on the top layer were sufficient for one evening.

Fishing with a night-light could reveal a whole new world to those who want only to sit and watch, and present valuable ecological material to others who care to make a study of the succession of life that is attracted and even hypnotized within its aura. The outstanding impression is the definite arrangement of the fauna according to size. The smallest forms, which are mostly invertebrates, come by the hundreds and mill around directly below the center of the light. Then in succession of size, fish and other forms circle around, each feeding on the next smaller until way on the outer circle, almost out of sight, the large fish stand watch for their prey and break the silence with a jump and a splash. One evening we were surprised by myriads of dainty butterfly-like baby flyingfish which drifted by with clump after



The larval form of the bonefish (above) certainly bears little resemblance to the adult fish (left).



Van Campen Heilner Photo.

clump of sargasso weed and deserted it for the light. These little fellows are usually in the open sea and were seen only this once close to shore. Another evening a small squirrelfish darted toward the light in a bewildered way and bumped into the base of the dock where it

was caught in a dip-net and reared in a tank. Although about three inches long, this squirrelfish was one of the smallest we had seen and caught. One other of this size is recorded in Bermuda literature. The resident squirrelfish around the dock are all larger and at least twice the size of this one. It was apparent that the small fish was an unwelcome visitor for, on following evenings when others came, all were chased and many eaten by the larger resident squirrels. On this same evening several "tummies" of tunas, caught on a feather jig one mile off shore, were brought to our laboratory. The "tummies" were crammed with squirrelfish similar in size to the one caught alive at our night-light!

On this particular August night as I lay flat on the dock watching the breaking waves while waiting for the small plankton to come—which in turn, would attract other forms—I wondered if any of the rare visitors of former watches would return. Suddenly an undulating white form, about four inches long, swam slowly toward my light from the direction of the open sea. For several minutes I dared not take my eyes from the creature because I knew that it would be impossible to find it again in the choppy waves. It drifted on the other side of

AUGUST

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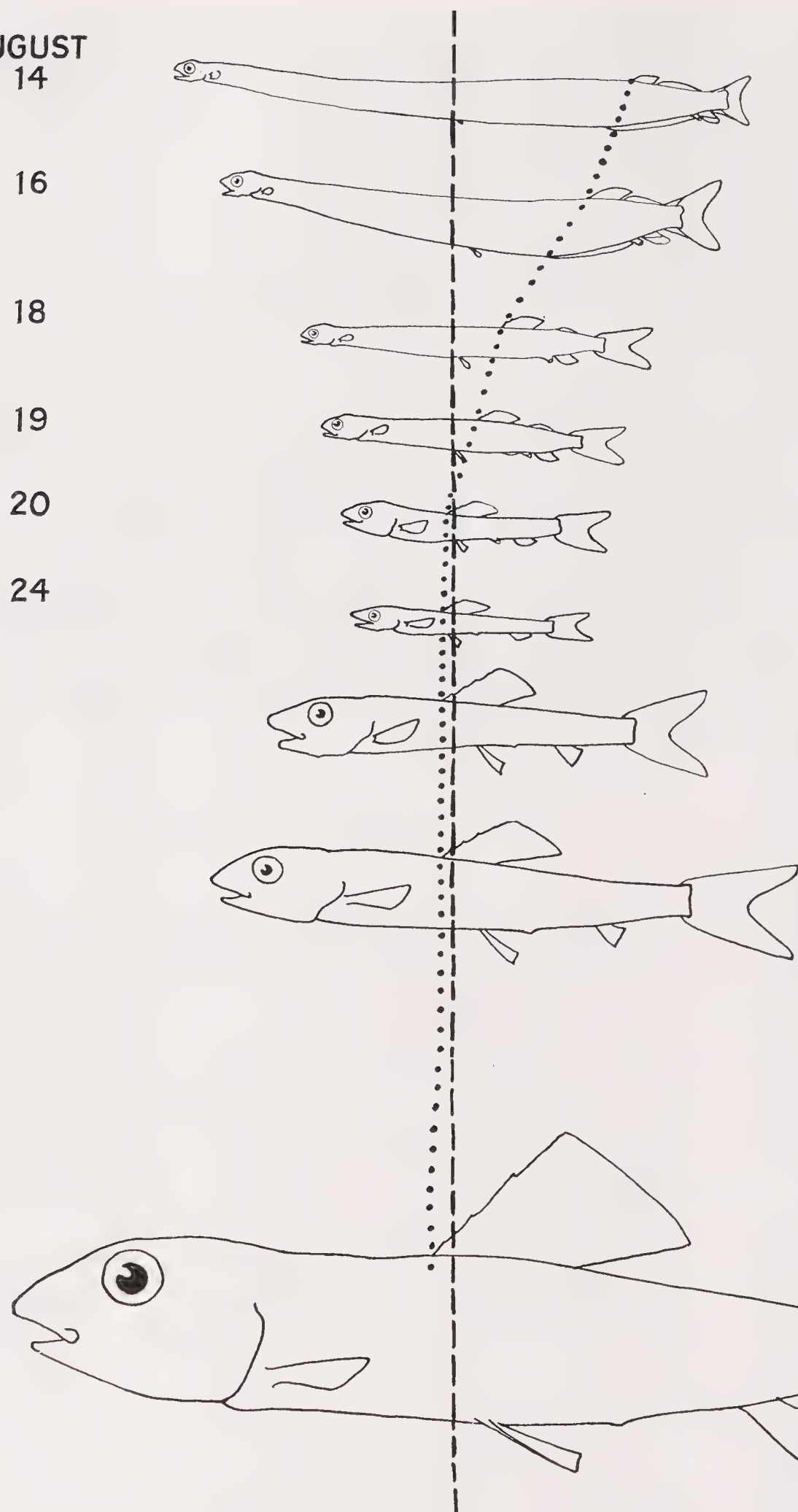
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Here are illustrated diagrammatically the various stages in the development of the bonefish, from the leptocephalid stage when it was dipped out of the ocean by the author, to the mature fish that would have been formed had it lived to complete the transformation. The dates are those of the period when the immature fish was under observation and was daily "growing up" by shrinking and the curving dotted line shows the advancing position of the dorsal fin. During the ten days of observation, the fish shrank from two and one-quarter inches to about one inch.

Drawing by George Swanson

be the only living one and the largest young eel of its kind that we had collected in Bermuda.

No sooner had I returned to my night-light vigil than a small silver dot was reflected by the light. This I followed for some time, knowing that it was the eye of a fish but not knowing what kind of fish it enlightened. Like the eel that had just been caught, it, too, was out of reach. But in a few minutes it was attracted nearer the center of the beam of light and then I saw a narrow, white, ribbon-like body

trailing behind the glistening eye. It was the young of the world-known bonefish, grubber, ladyfish, or *Albula vulpes*. Many have been caught in this stage when they resemble the young

the light at too great a distance for me to reach with my short-handled dip-net. For many minutes I was quite helpless, neither daring to move for a longer net, or take my eyes from the fish. Just when I could no longer stand the suspense and was about to make a rush for another net, the creature began to swim in my direction. It cautiously followed the outer circle of light. In a few seconds I scooped up a semi-transparent eel and placed it in safe quarters in our aquarium-boathouse. Here it lived and grew for many days and developed into an identifiable young eel. This specimen proved to

of certain eels and look not at all like their parents. At this particular time I happened to be working out the development of the skeleton of the *Albula* from the very young to the adult. Hoping that this one would be an intermediate stage in our collection, I decided to catch it. After submerging the hand net and slowly raising its rim around the fish, I held it there for a long time and watched this delicate spark of life. To lift the fish out of water would snuff out its life in a few seconds! As I watched it swimming around within the net I remembered the many that had come in our seine and surface

nets and their short survival after being pulled in. Almost without thinking I slipped a small glass dish into the water within the net and gradually raised it around the fish. This was done without touching or shocking the fish by lifting it out of water even for a second. The dish with the fish was then submerged in a two gallon tank. Before leaving that evening the fish's length, shape, and general description were jotted down. The next morning on the way to the boathouse I prepared a vial of preservative in which to keep the little *Albula* for study. Much to my surprise the fish was as lively as when captured the night before. I had even left it without an air supply.

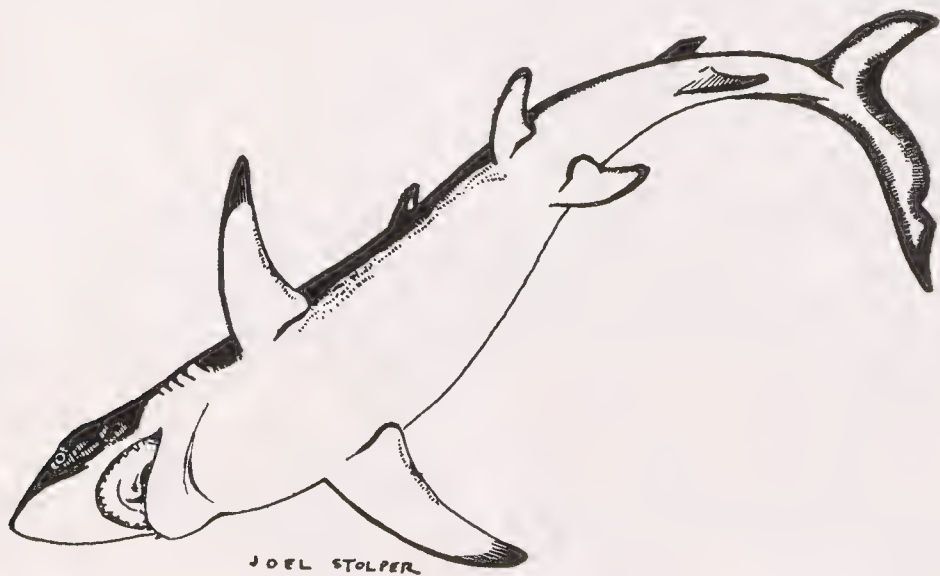
Not dreaming that the *Albula* would live over the second night and wanting to study it in the laboratory, I again dipped it up in a small pint dish. Here it continued to live for two days without air supply, food, or change of water. I was amazed to see during this time how rapidly it was changing. It then dawned upon me that this larval *Albula* should be given the best possible conditions. It was again placed in a two gallon aquarium with a good supply of air and food, which consisted of plankton dipped up each evening from under the night-light. The young *Albula* was two and one-quarter inches long (55 mm.) when it was caught on August 14. It was pure white and transparent and its small dorsal fin was way aft in position. According to daily measurements the fish grew more rapidly during the first four days; in fact, growth was less and less rapid on each successive day. Contrary to most fishes the growth in our living *Albula* was by decreasing in length. During the first forty-eight hours it decreased more than one-half inch (15 mm.) and during the following forty-eight hours it shortened about one-quarter of an inch (4 mm. and 2 mm. respectively). During the next four days the decrease in length was still less, being

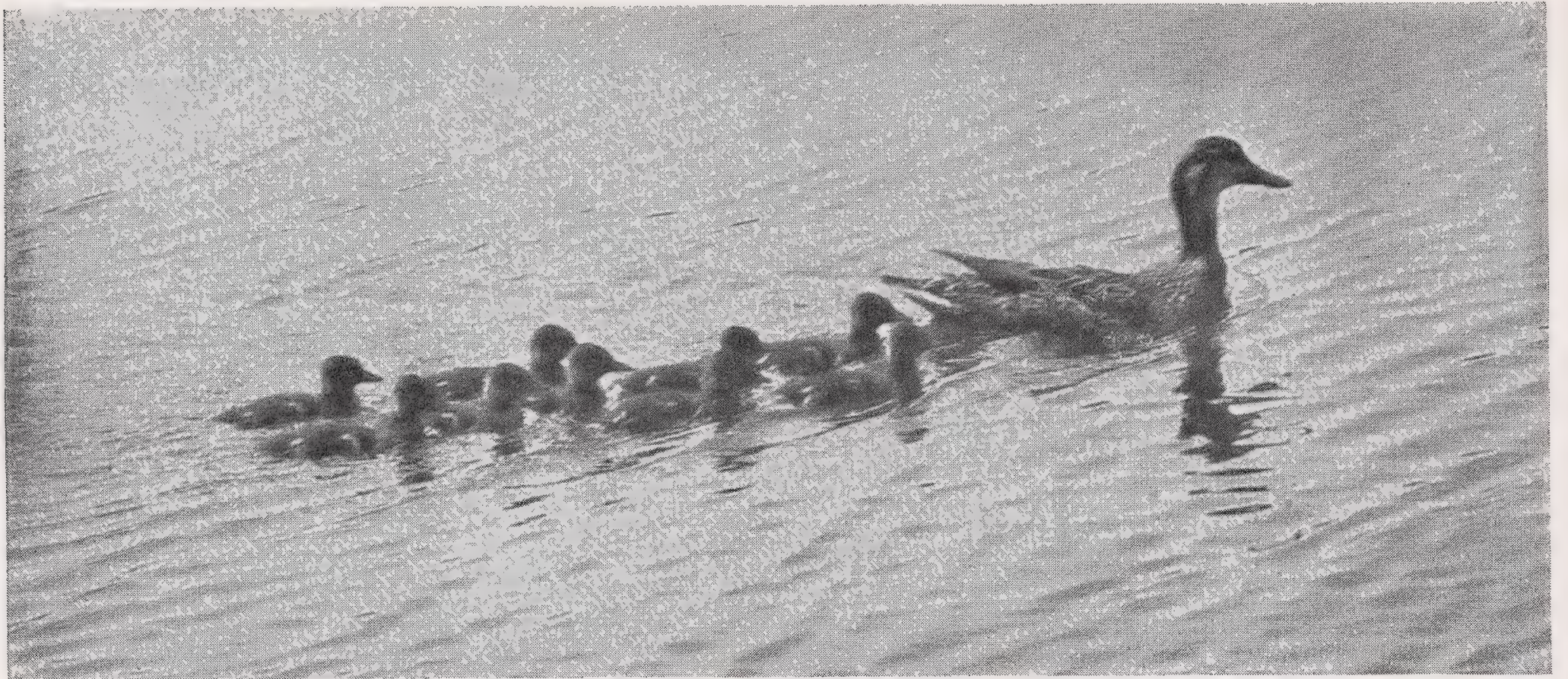
only a fraction of an inch, (0.03937th of an inch) or 1 millimeter. During ten days this living *Albula* larva changed completely before our eyes. It grew shorter and shorter, more round, more compact, more opaque and the dorsal fin developed from an insignificant one, in a posterior position, to a prominent fin in the center of the body. The little fish began to acquire color which first showed as dusky blotches mixed with yellow which in turn changed to dusky silver. When our *Albula* had decreased in length to about one inch (20 mm.), or a little more than one-third of its length when caught, it was a perfect miniature of its three-foot parent. It was identical in general form, position of the fins, proportion of the body, and hint of color.

Literature tells us about *Albulas* that range from three, or three and one-half inches, to two inches. This was recorded from preserved specimens.⁵ Our living *Albula* decreased in ten days from two and one-quarter inches to less than one inch, which gives us a hint of the amazing rapidity of transformation in this species of fish. From a one inch miniature-adult the *Albula* grows longer and larger; but we do not, as yet, know the length of time this takes. After having grown by shrinking for ten days our living *Albula* was attacked by fin fungus and in order to keep it for record and study it was preserved in spirits.

After consulting the card catalogue continuing the "Bibliography of Fishes" at the American Museum of Natural History, also all available older references, this is believed to be the first *Albula vulpes* to be reared from the leptocephalus to the young-adult form. It gives us a clue to the possibility of filling in the many gaps in the life histories of fishes.

⁵ Gill, Theodore. The Tarpon and Lady-Fish and Their Relatives. Smithsonian Miscellaneous Collection (Quarterly Issue), Vol. 48., May 13, 1905.





The Duck Fleet puts out to sea.

Nesting Time Around the Zoological Park

Birds Sometimes Choose Strange Places to Build Their Homes—Mallards in the Sea Lion Pool and a Robin in the Rainey Gate

CLAUDE W. LEISTER

LOCAL ornithologists know that Bronx Park, including the Zoological Park, is one of the best localities in New York City to observe migratory birds. The Bronx River valley is small, but it is advantageously situated and a favored migration route for many native species. Hundreds of thrushes and warblers, especially, use this highway on their journeys to the north and south.

Bird lovers also know that most local resident bird species can be found in this area. The appearance of this number of the BULLETIN coincides, in general, with the end of the spring migration and the beginning of the nesting season for the majority of these birds. In spite of the fact that very little suitable territory survives the demands of a rapidly expanding urban community, a surprisingly large number still build their nests and rear their young within the limits of the city. Providing one knows where to look for them, several dozen species can be observed in the course of a morning's walk.

The number and variety of birds nesting in the Park today makes a much less imposing list

than that of some thirty years ago when the Park was founded and this section of the city largely undeveloped. Since then many changes have taken place. Built-up streets have replaced open fields and meadows. Woodlands have been cut away, small lakes and ponds filled in and streams diverted to underground courses. But many birds have managed to exist on their ancestral nesting grounds and more or less adapt themselves to changing conditions.

When Mr. Crandall published his list of "Wild Birds in the New York Zoological Park and Vicinity," in the May, 1918, BULLETIN, sixty species were known to have nested up to that time. But even then a number of the former resident species had disappeared from their old haunts. Today only about fifty can be counted with any degree of regularity. The principal species to suffer have been those dependent upon marshland and open field areas. Woodland dwellers still abound in fair numbers.

Some former bird residents of the Zoological Park that have not nested in recent years, and are missed the most, are the scarlet tanager, rose-breasted grosbeak and the bluebird. Suit-

able places are still available for nesting but the temperament of these birds is such as to be considerably disturbed by the crowds of visitors now coming to the Park. The brown thrasher, after being absent for several years, nested with us again last year in a clump of shrubbery near the Rocking Stone.

Attractive and reasonably safe nesting sites are undoubtedly at a premium. This is especially true in parklands, where any tangle of undergrowth—appreciated so much and so necessary to birds—is frowned upon by park maintenance practice. During the early days of the depression, for the want of something better to do, the cleanup process in vacant areas was turned over to the none too tender hands of the unemployed. A large share of the work done was much too thorough and indiscriminate, to

the detriment of bird life everywhere. In the Zoological Park such actions were under closer supervision and results were more favorable. Unlike most other city Parks, the Zoological Park is surrounded by a fence. This prevents easy access to wandering bands of boys and other intruders and offers a considerable amount of protection to nesting birds. In effect, since the very first days, the Park has been a fenced sanctuary for bird life.

Robins have furnished us with several instances of the determination and single-mindedness of purpose which birds possess when they once decide upon a nesting site.

Considering the number of real trees in the Park, it was scarcely to be expected that a bird would choose the only artificial tree on the 264 acres of Park land for a nesting site. Neverthe-



Several broods of mallard ducks are hatched in the Zoological Park each spring and although the parents sometimes choose strange nesting sites, this nest happened to be secreted in a more normal spot among a tangle of vines in the Italian Garden.

less a robin nested last year in a bronze tree that forms a part of the Rainey Memorial Gate at the Concourse Entrance.

She inspected the possibilities of the tree during the last week in April and built a snug nest at the feet of a bronze flamingo. For more than a week the nest was untenanted, but early in May she settled down to rear a brood. According to a *Sun* reporter, who wrote an amusing story about the bird, she had made up her mind that a tree was a tree, whether it was cast in bronze or composed of cellulose.

When Kartoum was a young and rather destructive elephant, a pair of robins furnished us with another interesting example of nesting site selection. They had chosen a corner of the iron fence surrounding Kartoum's corral as a safe place to rear a family. There the nest was built, the eggs hatched and the young raised to maturity. Kartoum was fully aware of all that was going on, for he frequently explored the nest and eggs, and later the growing young, with the sensitive tip of his trunk. In spite of his deserved reputation for mischief making, he never caused them the slightest harm. Perhaps there was a mutual understanding that we humans fail to comprehend.

Because of the danger from falling limbs a dead tree on Park property is usually regarded as a menace and cut down immediately, thus destroying nesting sites for several species of birds, especially woodpeckers, nuthatches, crested flycatchers and wood ducks.

Some years ago Curator Crandall attempted to encourage the nesting of wood ducks in the Park by putting up nesting boxes in appropriate places along the Bronx River. For reasons known only to themselves the ducks failed to show much enthusiasm about the proposition and for the first years, at least, few boxes were occupied. But the gray squirrels in that end of the Park immediately called off house hunting and moved into the empty boxes. A pair of mallards, with a thousand more suitable places to choose from on the ground—their normal nesting place—took over one of the boxes and raised a family. Indeed, it proved to be so popular that it was used for several seasons.

In many instances birds seem to have no good reason for their selection of a nesting site. In this connection, the persistence shown by a pair of mallards in coming to the Sea Lion Pool every spring always evokes a considerable amount of comment from visitors who see them within the enclosure. The drake usually takes possession of one of the artificial islands in the pool and one year his mate was actually found within the sea lion's cave, although no eggs were laid there. A little later in the season, another, or perhaps the same pair of mallards, is certain to be found nesting in the Italian Garden.

In spite of the fact that our wood ducks failed to appreciate the nesting boxes built for them, they apparently desire to nest in the Park. The search for a nesting site must be a difficult one, since there is a definite lack of suitable trees. In the past, upon several occasions, a female wood duck has been found in the Administration Building, having come down the chimney and through the open fireplace, apparently mistaking the dark flue for a hollow tree. With all the accompanying difficulties, wood ducks do nest in the Park each season and last summer three broods of young ducklings were found on Lake Agassiz.

Some years ago a number of black-crowned night herons were successfully colonized in the Park and for a time they furnished an interesting exhibit on an island in Lake Agassiz. This colony finally came to include about a hundred birds and several dozen nests. Then the herons

deserted the Park completely and today no longer nest in the near vicinity, although summer brings a few individuals who have discovered that it is easier to steal fish from the stork paddocks than to



spear their own.

Like the wood ducks, other birds occasionally show a marked determination not to nest in places provided for them. Purple martins have proved to us that they possess more than their share of this characteristic. Through a period of about fifteen years a martin house was to be found at the south end of the Wildfowl Pond, finally falling into such a bad state of repair that it was taken down. Its removal marked

The thousands of real trees in the Park would not satisfy this robin and last year she built her nest and reared a family in the only artificial tree—a tree of bronze in the Rainey Memorial Gate. The same bird apparently returned this year and has investigated the gateway several times, but so far has not undertaken another nest.

the end of an effort to induce martins to nest in the Park. Although a large colony of these birds is established at Rye, where the colony actually seems to be overpopulated, and several female martins have stopped at the house for a few days during the migration season, none was ever sufficiently interested to take up permanent residence.

An unusual springtime phenomenon came to light a few days ago on the Wildfowl Pond where a pair of proud but unmistakably puzzled geese were seen with a fleet of mallard ducklings.

The Wildfowl Pond happened to contain two authentic mallard broods at the time. Curator Crandall noticed them at the south end of the pond—one mallard family with twelve ducklings and another pair with a rather small brood of four. Why there were so few in the second family was probably explained by the sight at the north end of the pond—the two geese with six young mallards.

The geese, a barnacle goose mated with a barnacle-Hutchins hybrid, obviously did not quite know what to make of the strange offspring they had accumulated. Young goslings show a great fondness for land and time after time the geese steered inshore and walked out on the bank, expecting the ducklings to follow.

Usually they veered off and chased bugs.

The ducklings were a trial in other ways to their foster parents. Whereas goslings are sedate and level-headed, the ducklings were never still a minute.

Curator Crandall had never before seen ducklings adopted by geese and he predicted the family would run into difficulties. Two days later the train behind the geese had been reduced to four—and one of the mallard families had an addition of two youngsters.



Four Eyes See Better Than Two

Anableps Is Equipped for Vision Under Water and in the Air
at the Same Time

C. W. COATES

AMONG the strange creatures of the world are the Four-Eyed Fishes, the Anablepidae, and it has long been our ambition to show one or two at the Aquarium. However, for reasons that yet are not quite clear, these creatures do not survive long in captivity and the collectors of fishes have succeeded in bringing very few from their native waters. Early this year a professional collector, Mr. Albert S. Pincus, captured six *Anableps anableps* along the banks of the Essequibo River and was fortunate enough to deliver alive to us five specimens. These were two females and three males and we had rather ambitious hopes of keeping them long enough to establish an aquarium strain for study.

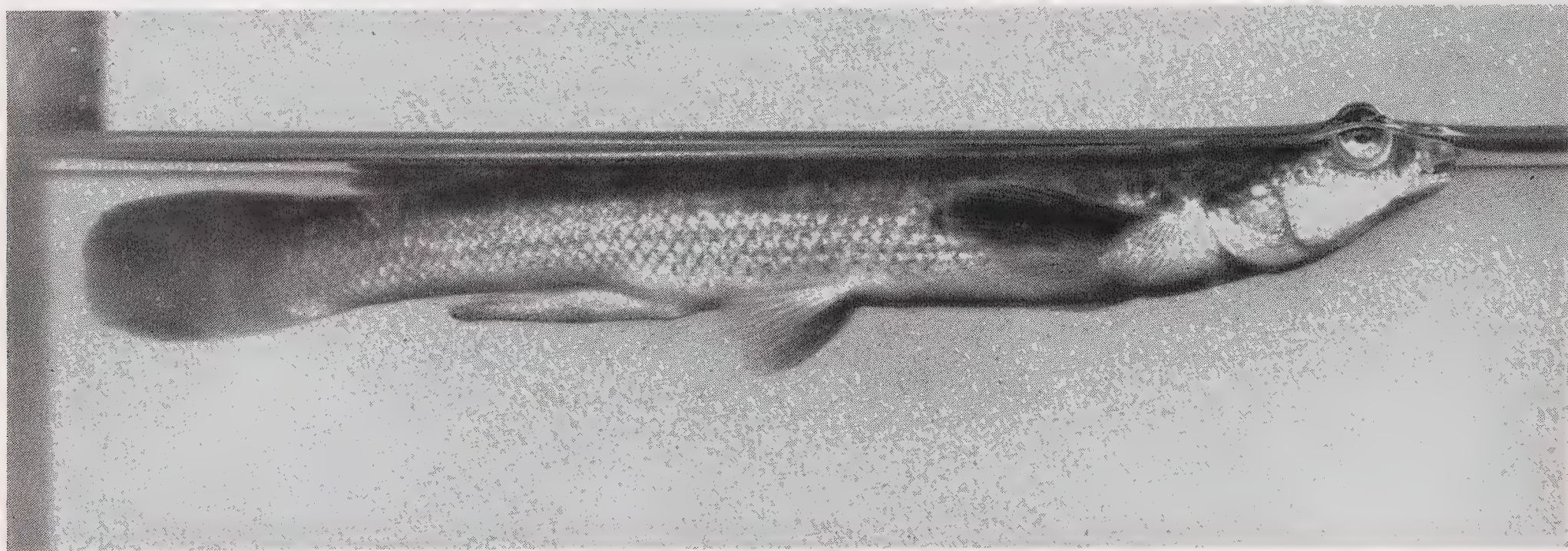
Knowing that the fish live along muddy river banks which are washed occasionally by ocean tides, we suspected that they needed fresh water with a modicum of salt and that one of the difficulties in keeping the creatures was the supply of a proper proportion of salt to their water. With this in mind we made a mixture of six parts of fresh water to one of pure ocean

water, a guess which seems to have been a good one, for the fish lived well and ate heartily—an excellent sign.

Two months later, by a lucky chance, an amateur collector, Mr. T. MacDougall, informed us that he had a few *Anableps* from Vera Cruz and would we mind making arrangements to take them off the boat on his arrival? After years of disappointment with these fishes we scarcely expected to receive specimens of two different species within a few months, but Mr. MacDougall delivered to us, in pretty good condition, six specimens of *Anableps dowei*.

These, too, seemed to like the admixture of fresh and salt waters, although they present a somewhat different problem since they were taken in streams miles away from the ocean. The waters were, however, highly alkaline, as is seawater. Although we have to check with no little care the waters in which these fishes are living, we still have five *A. dowei* and two *A. anableps* in our tanks.

We were anxious to procure these fish in order to study the peculiar eye structure and cur-



Here a Four-eyed Fish is floating at the surface of the water with the upper part of its eyes projecting. In this close-up photograph the contact between the eye and the water at the surface level of the latter can be seen very distinctly.



The Four-eyed fishes habitually swim at the surface of the water where their double vision is useful, and as one looks down on them their eyes look like bubbles floating in pairs.



A greatly enlarged picture of the head and eye of the strange fish reveals something of the structure of the eye divided for air and water vision at the same time.

ious external reproductive mechanism. Collectively the fishes are called "Four-Eyed," although actually they have only two eyes. However, each eye is divided into two parts by a horizontal division, the top part large and protruding above the line of the head, and the lower sunken. The fishes habitually swim at the surface of the water, the horizontal dividing line of the eye being exactly level with the surface. Consequently the upper part of the eye is above, and as one looks down on the water the two eyes look like small bubbles floating in pairs. The upper half of the eye is apparently adapted to vision in air, while the lower portion is adapted to vision in water.

Although the fishes swim at the surface, it was at once apparent to us that while they might catch food at or above the water level, they were perfectly well accustomed to bottom feeding too. We have never seen any of them jump out of the water after food if held

above it, but they will take floating vegetation or a roach swimming at the surface, just as will fishes with the more usual type of eyes. The purpose of the divided eye is not yet clear to us.

The fertilizing mechanism presents another curious anomaly. The fish is ovoviviparous, the eggs being fertilized and developing before they are spawned, as in the poecilids. To arrive at this the males of most of the fishes of this nature develop from the anal fin a sort of canal or duct through which the fertilizing agent is passed. These ducts can usually be pointed in any direction. However, in the Anablepidae the fin may only be bent in one direction, either to

the right or to the left. The females also exhibit this curious one-sidedness. There is a sort of scaly process which allows the fertilizing agent to be received from one side only.

These sinistral or dextral fish seem to occur haphazardly, according to no rule at all. Obviously it would be disastrous to the species as a whole if all the males and females developed right-handedness or left-handedness at the same time, which does not seem to fit into the general scheme of natural economy. It is our hope to find out the significance of this strange development, now that specimens are likely to be available for study.

Long-lived Fishes in the Aquarium

Two Have Reached the Age of Thirty Years, While Major Flower Cites Records of Double That Age

C. M. BREDER, JR.

THE subject of longevity of animals has long been of interest to Major S.S. Flower and numerous papers have been prepared by him on the subject. Recently he has brought forward one of special interest to the Aquarium, "Further Notes on the Duration of Life in Animals. 1. Fishes: As Determined by Otolith and Scale-Readings and Direct Observations on Living Individuals."¹

His paper lists records of longevity from the principal aquariums of the world and of the complete records mentioned, a goodly portion refer to those of the New York Aquarium, especially if numerous species we have never been fortunate enough to obtain are excluded.

Other than an extension of six years to some species, little can be added at this time, since Flower's records for this institution are based on Miss Ida M. Mellen's "Complete List of Exhibits at the New York Aquarium,"² which appeared in 1919, and Dr. C. H. Townsend's "The Public Aquarium, Its Construction, Equip-

ment and Management,"³ published in 1929 with records for 1928.

Since the appearance of this latter publication, the long-nosed gar, *Lepidosteus osseus*, and the bowfin, *Amia calva*, have reached the age of thirty years. The giant grouper, *Promicrops itaiara*, died at the age of twelve years. A large dog-snapper, *Lutianus jocu*, that was already an unusually large specimen when received, is now in its twelfth year and still going strong. Six rock bass, *Ambloplites rupestris*, have reached eighteen years. It is noteworthy in connection with these that as usual they spawned with the coming of last spring and the eggs produced viable and normal young. Some species of sunfish, *Lepomis auritus*, *L. pallidus* and *Eupomotis gibbosus*, may also equal this age, but it is somewhat uncertain, because of addition of other specimens from time to time that are now indistinguishable. From these ages the fishes grade on down to recent accessions. Since the Aquarium came under its present administration in 1902, it is clear that records could

¹ Flower, S. S. *Proceedings of the Zoological Society of London*, pages 266-304, July 4, 1935.

² Mellen, I. M. *Appendix to Twenty-third Annual Report of the New York Zoological Society*, pages 16-38, 1919.

³ Townsend, C. H. *Report of the United States Bureau of Fisheries for 1928*, Appendix VII, pages 249-337.

not reach much further than some of the above.

It is interesting to note that of the seven species that Major Flower lists as having exceeded thirty years in captivity, only two are not open to question. They are the lobe-fin, *Polypertus senegalus*, 34 years old, and the Schall catfish, *Synodontis schall*, 31 years. The others are the wels, *Silurus glanis*, 60 years; European eel, *Anguilla anguilla*, 55; American eel, *A. chrisypa*, 50; carp, *Cyprinus carpio*, 47; and the sterlet, *Acipenser ruthenus*, 46. All have a sufficient vagueness about them to place them in the category of uncertain records. In such long stretches of time so many things can happen to a fish, especially when confined in ponds, that those of us who are working continually with these animals become peculiarly suspicious of stories that involve the certainty of a number of people. This is in no way to be construed as a criticism of Major Flower's catalogue of ages, as he makes perfectly clear the unreliability of old records.

In connection with the age attained by fishes and their life expectancy, there are several items of interest. Many fishes do not have the potentiality for as long a life as the above records. At the other end of the scale are the so-called annuals—small fishes in which the life cycle is more like that of many insects. After maturing within a single year they spawn and die. In the case of the common guppy of aquaria, none seem to survive more than an extreme of three years. This is rather hard to detect because of their great productivity. Only with the greatest care may one be sure in a period of a year or more that some daughter fish has not been confused with her mother. It might be fair to say that the average age of the various species of local fresh-water and marine fishes that do not grow to more than two feet fails to extend beyond five years. This opinion is not based on aquarium observation, but on age estimation of wild fish by means of the annual rings laid down on the scales. These give a good guide to age, somewhat similar to the age rings of trees.

This brings us to another matter in the aging of fishes. There seems to be two kinds of age limitation normal to fishes, either or both of which may be operating in a given species or

individual. Death may follow because of sheer inability of the organism to go on living. This, true senility, is a physiological matter in which the organic mechanism may be thought of as simply "running down." Death, on the other hand, may follow for no such reason, but may ensue, nevertheless, at some more or less definite age limit because of external factors in the environment. These would include all cases in which predatory forms succeed in catching all individuals before old age can show its effects. Parasitism might be a similar manifestation in which destruction of the host eventually takes place. In both cases such death must be deferred until after adequate reproduction has taken place, in order to insure perpetuation of the species.

Given a specimen that is "cut off" before its time because of numerous enemies, it follows that in captivity, if of a satisfactory sort, life may be continued far beyond the average of the wild fish. Such would seem to be the case in some of the records here mentioned. On the other hand, some species, such as the guppy, produce countless generations in captivity with unabated vigor. Nevertheless, so far as individuals go, there is here a definite limit on length of life. This, then, is surely due to an inherent senility.

Until much more is known of the length of life of given species, both in captivity and in the wild state, it is difficult to make any very definite pronouncement as to which is physiological and which environmental. Much statistical study would be necessary to settle most of the questions that arise in this connection.

Records among the smaller tropical fresh-water fishes are limited by the fact that the department exhibiting them was only established in 1930, so such records only run to a five-year limit. Of these there are a considerable number but until further time has elapsed a listing of them would hardly be significant. There are, however, several cases in which specimens have reached in captivity a much larger size than recorded wild specimens. This may be associated with an absence of predators, or with captive conditions being an improvement on the environment they come from—but that is another story.

BULLETIN

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Back Numbers Wanted

Several numbers of the Society's technical publications, *ZOOLOGICA* and *ZOOPATHOLOGICA*, are out of print and to complete files being prepared for binding the Department of Publication and Photography would be grateful for the gift of copies that the recipients may have in duplicate or no longer care for. The issues particularly desired are:

ZOOPATHOLOGICA: Volume I, Number 1. Some New Species of Parasitic Trematodes of Marine Fishes. *MacCallum*. 1916.

ZOOLOGICA: Volume IV, No. 5. The Locomotion of Fishes. *Breder*. 1926. Volume VII, No. 1. The Three-toed Sloth. *Beebe*. 1926.

One issue of the Annual Report of the Society is also out of print and there have been occasional requests for copies which the Department of Publication would like to supply if unwanted copies are returned. This is the report for 1912, No. 17.

Barney Is Weaned

Although he was getting on toward his first birthday and was quite large enough to dive for fish at the side of his parents, Barney, the young sea lion, steadfastly refused to go on a fish diet this spring. His mother was impatient with his efforts to nurse and occasional ice in the Sea Lion Pool made matters more difficult.

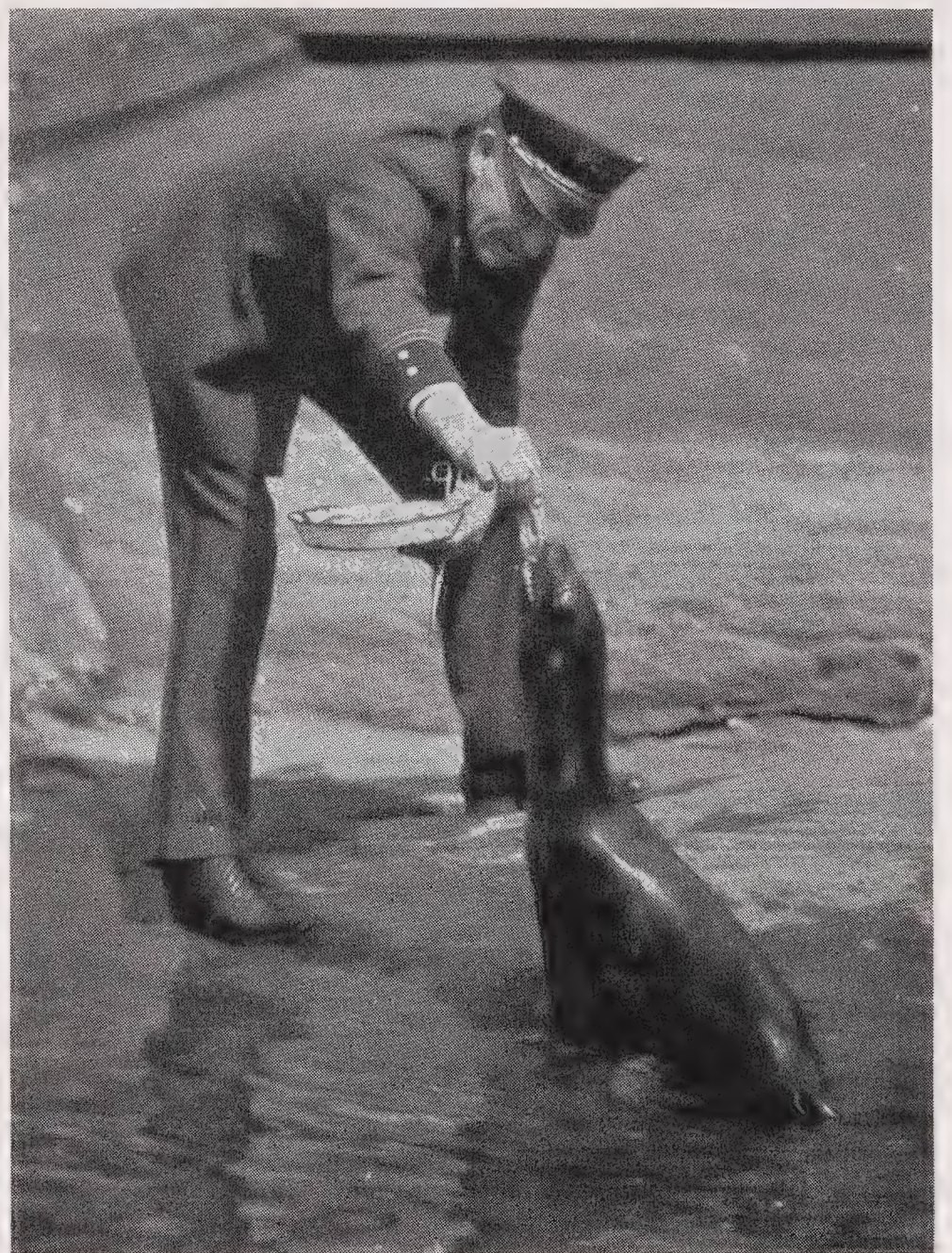
The pup passed several days without being seen to take food and then he was caught and transferred to the Hospital to be weaned. At first he was allowed to continue with milk, which he took from a bottle. Gradually he was taught to drink from a pan, and then the pan began to contain fish and Barney took them in his stride.

In the Hospital about a month, he has been completely weaned and now shows the typical zest of his kind for raw fish when it is tossed into his private pool southeast of the Reptile House.

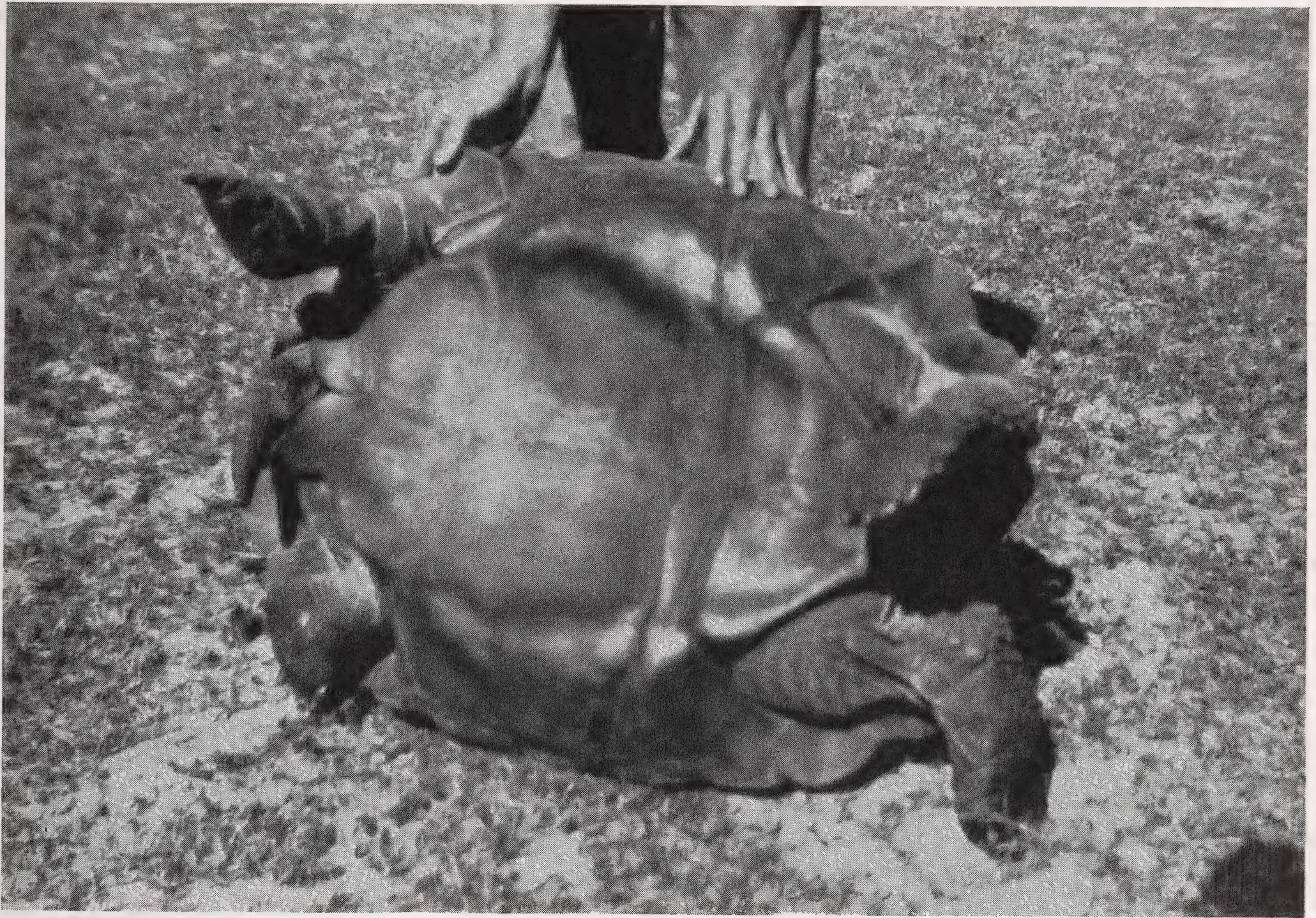
It is planned eventually to return Barney to the large Sea Lion Pool in Baird Court but he is apparently well satisfied with a solitary existence in the little pool where the water is plenty deep enough for diving.

Disinclination to change from milk to fish is not uncommon among sea lion pups in captivity and some time ago the Philadelphia Zoological Garden reported the same difficulty that was experienced here.

The young sea lion will be one year old on June 1.



Barney is on a fish diet now.



The curving plastron of the male Galápagos tortoise is an accurate index of its maturity and the approach of the breeding age. Recently this large tortoise in the Florida collection has developed a strong curve that will continue to deepen.

Two Giant Tortoises Were Swept Twenty Miles by Hurricane

C. H. TOWNSEND

As most members of the Zoological Society are aware, the Society has several colonies of Galápagos tortoises located at points in the South. They are being specially cared for in the hope that this rapidly disappearing species can be bred in captivity and thus saved from extermination.

There are forty of these tortoises now in the colony at Opa-Locka near Miami, Florida. Some of them were, until last fall, kept on Lignum Vitae Key, near upper Metacumbe Key. After the hurricane of September 2 most of the tortoises on Lignum Vitae were removed to the zoological garden at Opa-Locka. Two of them, however, were missing. They had previously escaped from their enclosure on the higher part

of the island and must have been near the shore. Wherever they were the hurricane found them and took them for a ride.

While inspecting the colony of tortoises at Opa-Locka late in March, the writer received one of the long-missing tortoises. It was found in the jungle at Cape Sable by Mr. E. L. Wild of the U. S. Department of Agriculture. This tortoise weighed 165 pounds when brought in and was still wearing the copper number riveted to its shell (No. 10). It had fared well during its seven months' stay at Cape Sable and is now the heaviest tortoise in the Opa-Locka colony.

Mr. Wild reported that the other tortoise, also washed ashore at Cape Sable, had been found by some Negroes who killed and ate it.

The survival of these two dry-land mountain tortoises, after being swept twenty miles across the Gulf of Florida from Lignum Vitae to Cape Sable, is an amazing fact. The force of the hur-

ricane was terrific. It must have carried the tortoises at great speed or they would have been drowned. Metacumbe was swept clean. The railway, highway and all homes were destroyed. There was great loss of life—about 170 persons. Railway ties, telegraph poles, trees and the wreckage of houses washed up on Cape Sable in great masses. When the mountainous seas swept across Metacumbe a native found himself in the water clinging to a telegraph pole. He thought himself started for a trip across the Gulf but was almost immediately thrown ashore on Lignum Vitae, four miles under the lee of Metacumbe.

Perhaps the wreckage and the tortoises made the 20-mile trip, before the awful speed of the hurricane, in twenty minutes—who knows?

Dr. Kimball, meteorologist in charge of the New York office of the Weather Bureau, thinks my suggestion of 20 miles an hour as the possible rate of speed at which the tortoises were carried to Cape Sable, is not excessive. He remarks that it is practically nothing as compared with the known speed of the hurricane.

It should be borne in mind that the animals in question are not long-flipped sea turtles, but stubby-legged land-tortoises, having little swimming power and being totally unable to dive. They must have—tortoiselike—withdrawn their heads and legs tightly under their protective and hard shells, and been rolled continuously in the tempestuous drive of the waves.

It looks as though Nature had blessed the Galápagos tortoise with a rugged constitution.

One more disaster, after the hurricane, threat-

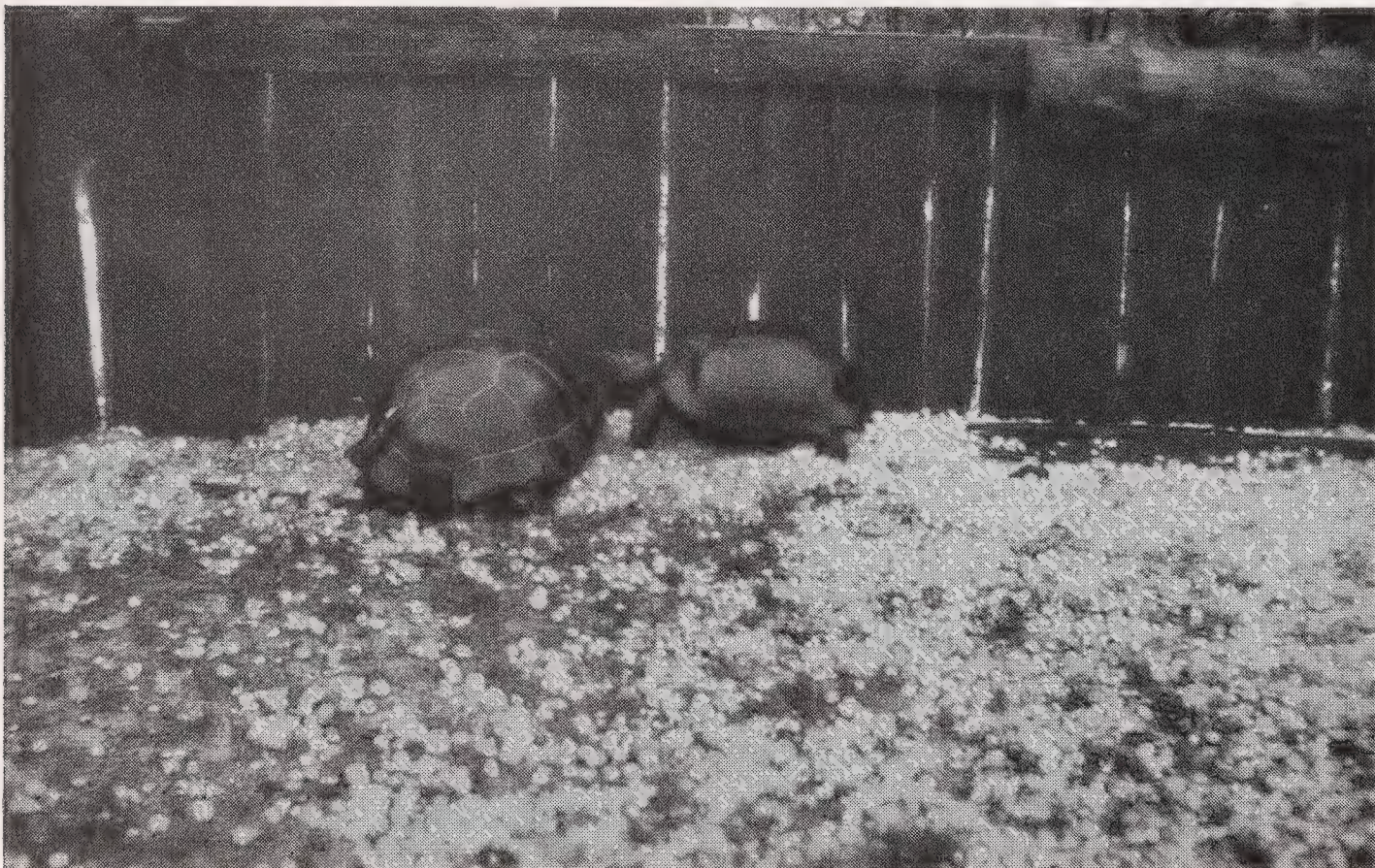
ened the tortoise colony in Florida. That was a most unusual one—a severe hail storm, with the attendant danger of exposure to the chilled ground and contact with the pellets of ice.

An account of the hailstorm was forwarded by the manager of the Opa-Locka park. He said that late in the afternoon of Sunday, April 26, a rain and hailstorm sprang up and for twenty-two minutes the earth was pelted with balls of ice that ranged up to half an inch in diameter.

Unaccustomed to such phenomena, the park was totally unprepared and animals that could not get to shelter easily were compelled to stay in the open and take the worst that the skies sent. The moment the storm was over, the tortoises that had been caught in an open corral were driven and dragged inside of a warm and dry shed where straw bedding was spread for them and where they could be completely covered by straw. They were, of course, unharmed by the striking force of the ice itself, protected most efficiently by their shells, but some ill results were feared from exposure to the coldness of the hail. However, they seemed to be entirely unharmed and the following day they were again at liberty in the warm sunshine.

Mouse No. 48

For a snake that has always before proved to be extremely difficult to keep alive in captivity, the Trinidad bushmaster at present in the Reptile collection is making an excellent record. Since its capture last summer the snake has been feeding regularly and early in May consumed its forty-eighth mouse.



Hail was a new experience in the lives of these Galápagos tortoises at Opa-Locka, Florida, but they showed no ill effects. The hail fell for twenty-two minutes and when the storm was over, the tortoises were placed in a warm, dry shed.



Sudana Celebrated the Arrival of Spring in Her Own Way

WILLIAM BRIDGES

Seldom does spring come to the Zoological Park without an incident that gives someone cause to remember it. There was one spring when a Galápagos tortoise and a white peacock struck up a strange friendship and were inseparable for weeks, another when a casual inspection of a black alpaca sunning itself on a chilly day discovered four rats cozily sheltered in its long pelage. The first release of the animals from their winter quarters always means a day of excitement and high spirits, and this year vernal incident concerns the liberation of the elephants.

Except for Alice's unauthorized promenade in the Park on February 4 when she broke out of her stall during the night because of cold water rising from a clogged drain, none of the inmates of the Elephant House had been outside since last fall. On April 21 a strong sun and mild breezes raised the temperature to the safe level of nearly 80 degrees and the doors of the Elephant House were opened for the first time in five months. Alice and Sudana and Runga celebrated their freedom by shrill squeals and frequent trumpeting and a thorough exploration of their corrals. They begged every passer-by for peanuts and in sheer excess of energy abandoned generous donors to go lumbering off to some other corner of the yard.

The black rhinoceros playfully charged everything in sight, lowering her head and tearing around the circumference of her fence at a half-gallop. The young pigmy hippopotamus viewed the outside world for the first time, but with the utmost stolidity and indifference. *Hippopotamus amphibius* also pretended insouciance but he was seen to open his enormous jaws to their fullest and clamp them down on the tender head of a dandelion—which either argues a complete abandon to the elixir of spring or proposes a companion to the question why anything as large as an elephant should be interested in anything as small as a peanut.

When the sun sank low in the late afternoon and the first day of freedom was over, most of the animals returned to the warmth of their stalls with little more than the usual urging. Runga wore an air of spring lassitude and retired sedately. Alice was moderately willing to obey orders and go back to her stall. Only Sudana stubbornly tramped around the outside edge of the corral and resisted the invitation of the open doorway.

Some years ago the lure of the spring had been too great for Sudana's self-control and she had to be shackled and dragged in by Alice. But the process of shifting an unwilling elephant is a considerable one and Curator Ditmars hesitated about undertaking it late in the afternoon when several of the keepers had already left the Park. He inspected the weather map and consulted the Weather Bureau. There



(Above). Cope Lake is white-starred with flowering trees during May. (Below). Spring comes officially to the Park when the pelicans are liberated in the big Flying Cage in early May, after being housed in a warm building all through the winter.

was a strong probability that while the temperature would fall considerably during the night, it would not decline to a dangerous point. It seemed safe to let Sudana have her way this time and spend the night outside. Dr. Ditmars figured, anyway, that Sudana would get over her whim before the night was out and would be glad to have the shelter of the stall. So he ordered the other animals locked in and Sudana's door left open.

His estimate of Sudana's character was all wrong. The thermometer fell steadily during the night to a low point of 36 degrees and the day dawned chilly. The arriving keepers found Sudana still outside and still apparently enjoying her truancy.

The morning was not warm enough to turn the other animals out and if the coolness continued Sudana would be much better off inside. Alice was ordered out to assist and a crew of four men set to work. Sudana resisted with all her might; she braced her feet when Alice pulled and she finally lay down when Alice pushed—lay down in the very door of her stall.

Alice gave up in disgust and the keepers and their helpers dragged and coaxed. Eventually Sudana recognized the uselessness of her struggle and got up and walked the last few steps by herself.

As a result of overnight exposure she suffered a slight cold in one eye but it cleared up rapidly and she showed no other ill effects.

The Great Indian rhinoceros embarrassed the Mammal Department on the day of the spring Garden Party. With the whole collection clean and in perfect order, the rhinoceros wandered out into its corral and immediately discovered a large puddle left by a heavy rain the day before. A preliminary trampling around and through the puddle reduced it to thick and sticky mud—and then the rhinoceros lay down in it and coated every inch of its hide, as well as splashing the adjacent fence. Before the party the keepers washed the animal with a hose as best they could.

Spring comes officially to the Park on the day the aquatic birds are liberated in the big Flying Cage after a winter in steam-heated



Banks of azaleas on both sides of the Concourse parking space delight the eyes of visitors to the Park. The bright blossoms are in full color during May.

quarters off of exhibition. The pelicans and sea gulls were turned loose on April 30, a warm, mild day, and the remainder of the collection—herons, ibises, spoonbills—on May 11. They, too, feel the excitement of their comparative freedom and spend hours exploring all parts of the cage.

Signs of spring are clearly visible in the Prairie Dog Corral by early May. When the little animals begin dragging out the dried grass that served them as bedding in their burrows during the winter, fresh grass is provided and they refurnish their houses.

The snakes that always attract crowds around the Snake Island in summer are seldom able to go outdoors permanently before late May, but this year the occurrence of warm sunshine on the day of the Garden Party brought them out early for that day only. Fully one-third of the non-poisonous part of the reptile collection was on display—boas, pythons, bullsnakes, pine snakes, water snakes, South American iguanas and ten Galápagos iguanas. For fear that water in the moat would chill them, it was kept dry and Keeper Taggart was stationed on the island to haul out the snakes that found their way to the bottom of the moat and were thus out of sight.

Ever since the founding of the Park the foresters have consistently planted flowering trees and bushes where their spring colors would

be effective and this spring fully a dozen species were in blossom at the same time during early and mid-May—lilacs, viburnum, azalea, dogwood, shadbush, snowdrop tree, Carolina rhododendrons, flowering crabapple, Japanese cherry, hawthorne, Judas tree and Japanese quince.

An Otter Once More

Through the generosity of Mr. Childs Frick, an otter (*Lutra canadensis*) has been added to the Small Mammal collection—the first otter to be exhibited in almost fifteen years. The animal was reared in captivity in Minnesota and was well tamed when it came to the Park. It is about half grown.

Many years ago a pair of otters was exhibited in the Reptile House and on a previous occasion a water cage was built for another pair in the Wildfowl Pond. They spent so much time in the water, however, that they were very unsatisfactory exhibition animals.

The new specimen is confined in the Small Mammal House where it has an indoor cage, an outdoor runway, a small tank of water, and an ingenious sleeping apartment specially built for it. The sleeping cage is a long, low box, with a door in one side for access. The top is hinged and can be opened to permit the keeper to change the bedding. The floor of the box is a heavy wire netting, which can easily be kept clean.



The otter's sleeping box is ingeniously arranged for sanitation and comfort. Bedding is placed on a wire netting that can easily be cleaned and the top of the box is hinged to permit access for cleaning.

PUBLICATIONS

Free to Members:

Bulletin: The official publication of the New York Zoological Society reports bi-monthly on interesting phases of work at the Park and the Aquarium and contains articles on natural history in a sound yet popular form, with many illustrations. Thirty-eight volumes have been completed.

Zoologica: Scientific contributions of the New York Zoological Society. Volumes I-XIX are complete, and other volumes are in preparation. *Zoologica* is illustrated, and is published as material is presented. It is sent to Members on request.

Zoopathologica: Scientific contributions of the New York Zoological Society on the diseases of animals. Volume I and II are completed. It is illustrated, appears when material is available, and is sent to Members on request.

Annual Report: Documents, reports and pictures of the work of the various departments of the Park and the Aquarium. As a rule it contains articles of scientific value and considerable general interest.

Gallery of Wild Animal Paintings in the Zoological Park: A handsomely illustrated catalogue of the gallery in the Administration Building at the Park, which Members may receive on request.

Some Books by Members of the Park Staff:

Beebe: HALF MILE DOWN. 344 pages, 123 illustrations and 8 colored plates. 1934. \$5.

An account of the deep-sea explorations of the Department of Tropical Research in the bathysphere.

Blair: IN THE ZOO. 195 pages, 55 illustrations. 1929. \$2.50.

Entertaining and informative animal stories drawn from long experience in the Zoological Park.

Crandall: PARADISE QUEST. 226 pages, 52 illustrations. 1931. \$3.50.

A vivid description of a successful expedition to New Guinea in search of Birds of Paradise for the Park collection.

.....: PETS AND HOW TO CARE FOR THEM. 296 pages, 96 illustrations. 1930. \$2.

A practical manual for everyone who keeps animal or bird pets.

Ditmars: CONFESSIONS OF A SCIENTIST. 241 pages, 39 illustrations. 1934. \$3.50.

Adventures in collecting and maintaining animals in the Zoological Park.

.....: SNAKES OF THE WORLD. 207 pages, 84 pages of illustrations. 1931. \$5.

A comprehensive book of reference on the snakes of the world.

Leister: PRESENT DAY MAMMALS. 74 pages, 106 illustrations. 1931. \$1.

A valuable classification and reference book for schools and students of zoology.

All these books and others by the same authors may be obtained from the New York Zoological Park. For book express add 15 cents postage for each volume.

A classified list of the publications of the Society, with subject headings of articles printed in the *Report*, *Zoologica* and *Zoopathologica*, as well as reprints from them, will be furnished on request. Some of the publications have become exhausted and orders for any issues will be governed by this circumstance. Orders for any of the publications should be addressed to H. R. MITCHELL, *Manager, Zoological Park*, 185th street and Southern Boulevard, New York City.

No effort will be spared to ensure delivery of the regular publications to Members of the Society, but changes of address, forwarding points and non-delivery of mail should be reported promptly. Back numbers of *Bulletin* still in print will be supplied to Members and others at the rate of 30 cents each. Postage and handling, 5 cents extra.

Clark and Fritts, New York, Printers.

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NEW YORK ZOOLOGICAL SOCIETY



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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

Annual Membership in the Society is \$10, renewable annually. Life Membership may be obtained for \$200. A contributor of \$1,000 becomes a Patron; \$2,500 an Associate Founder; \$5,000 a Founder; \$10,000 a Founder in Perpetuity, and \$25,000 a Benefactor.

All classes of Members are entitled to receive every periodical publication, the privileges of the Administration Building with its lounges and reception rooms and gallery of paintings of animals, to attend lectures, open meetings and entertainments, and to be admitted free to the Zoological Park and the Aquarium every day in the year.

Application for Membership may be given to the Director of the Zoological

Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 101 Park Avenue, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



From the bungalow of a Tobagan planter, a rift in the
cocoanut palms gives a view of the "Hardi Biaou"
riding at anchor in King's Bay.

BULLETIN

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A West Indian Grand Tour

The Department of Tropical Research Makes a Seven-Weeks' Visit in the Caribbean Area and Reports on Its Accomplishments

WILLIAM BEEBE

PART I

RÉSUMÉ OF THE EXPEDITION

ONCE again it has been the privilege of members of the Department of Tropical Research to make the Grand Tour of the West Indies, our Twenty-second Expedition, with definite scientific objects and under conditions which rendered possible their accomplishment.

Dr. and Mrs. Henry D. Lloyd placed their yacht *Hardi Biaou* at our disposal from January 22 to March 13. This vessel was formerly the *Pawnee*, designed by Mr. Harry Payne Bingham for oceanographic work, with laboratory, aquariums and glass-bottomed boat. So we found it eminently adapted to our needs. Our party included Dr. and Mrs. Lloyd, Mr. and Mrs. Carrington Lloyd, Miss Jocelyn Crane, Mr. John Tee-Van and myself.

The three principal things I wished to do on this trip were: First, to make as thorough as possible a study of the black and the yellow-finned tunas which are taken between Martinique and St. Lucia. Second, to see and report on the birds of paradise introduced on Little Tobago many years ago from New Guinea. Third, to begin an investigation of the boundary between the fish fauna of the West Indian region and that of South America.

We began and ended the cruise with Jacksonville, spending from one to nine days in the Virgin Islands, Martinique, St. Lucia, Union Island, Grenada, Tobago and Little Tobago,

Trinidad, Margarita, La Guaira, Curaçao, Jamaica, Santiago, the Isle of Pines and Havana. This resulted in an hour-glass ellipsoid orbit and a total run of over 4,600 miles.

After we left Jacksonville we did not make port for six days, steaming south along Florida, then eastward through the Bahamas, and north of Haiti and Porto Rico to St. Thomas in the Virgin Islands. The storms which for weeks had gripped New York reached after us and the cross winds, waves and currents made no distinction between our 455 tons and a casual floating chip. Twice, at night, to break the monotony of unpredictable movement, we ran to shelter in the lee, first of Cat and then of Crooked Island.

At the former, in the blackness of night I let down a line and pulled up one of the most beautiful of fish, with *Malacanthus plumieri* as its euphonious technical name. The Spanish also sing when they call it *matajuela blanca*, which we can only lamely imitate with the unlovely "whitey." It is slender, with long rippling fins, and its scales are a harmony of pastel shades. The body is rich purple, shot with zigzag bands of creamy brown, the head yellow-green with parallel blue lines connecting snout and eye, the tail with its slender streamers and the long body fins have flickering tints of yellow, purple and sepia, all subdued, all appearing and disappearing, foiling completely

Photographs and map in this article by John Tee-Van.



any artist's attempt. Vaguely, it is related to such fish as stargazers and dragonets, but its family stands apart, awaiting more close and sympathetic study than has been accorded to it. I found the fish had been feeding on little elephant-tusk shells known as *Dentalium*. This association was interesting, for these too are creatures without near living relatives, although they are among the First Families among mollusks, going back well over 400 millions of years to the Middle Silurian. One had been swallowed so recently and so whole that it still showed signs of life. I hopefully searched within its apology for a stomach and found a cluster of diatoms. These latter, unfortunately for my continuity idea, have untold hosts of near relations.

Looking into my microscope and lulled by the

blessed relief of a gentle, rhythmic roll, I began to marvel at the sequence of events—expedition, storm, haven, fisherman's luck, the *matajuela's* food, the *Dentalium's* subsistence—all of which had a part in leading my eyes to the diatoms. But at this moment another fish was announced and I abandoned my vaporings on the luck of chronological successions.

Compensation for the roughness of the days came in the increased number of flyingfish which came on board at night, and twice out of the tossing waves we saw schools of the ever mysterious flying squid. (See the BULLETIN for September-October, 1932, Page 177).

On January 29 we entered the harbor of St. Thomas and spent two days among the outer reefs and bays. The result was 65 species of fish with nine or ten more of uncertain identifi-



*Saba, at the left, is the most dramatic of the West Indian islands. The capital, Bottom, is reached by 800 steps. The surf was pounding heavily on the landing beach as the "Hardi" passed, so the party sent up friendly whistles instead of attempting to go ashore. Below is the yellow-finned tuna, *Neothunnus argentivittatus*, which reaches a length of six feet and a weight of more than 400 pounds.*

cation. There is little of beauty or interest in this colony of ours, except Mafolie. And Mafolie has the same effect on me as the Kaaba on a Mohammedan, or a magnet on iron filings. This time I found a well-oiled 'bile road, but progress had in no way disturbed the sheer glory of the view from the summit of Mafolie, down and across jungle and palms to the heart-shaped bay of fire opal.

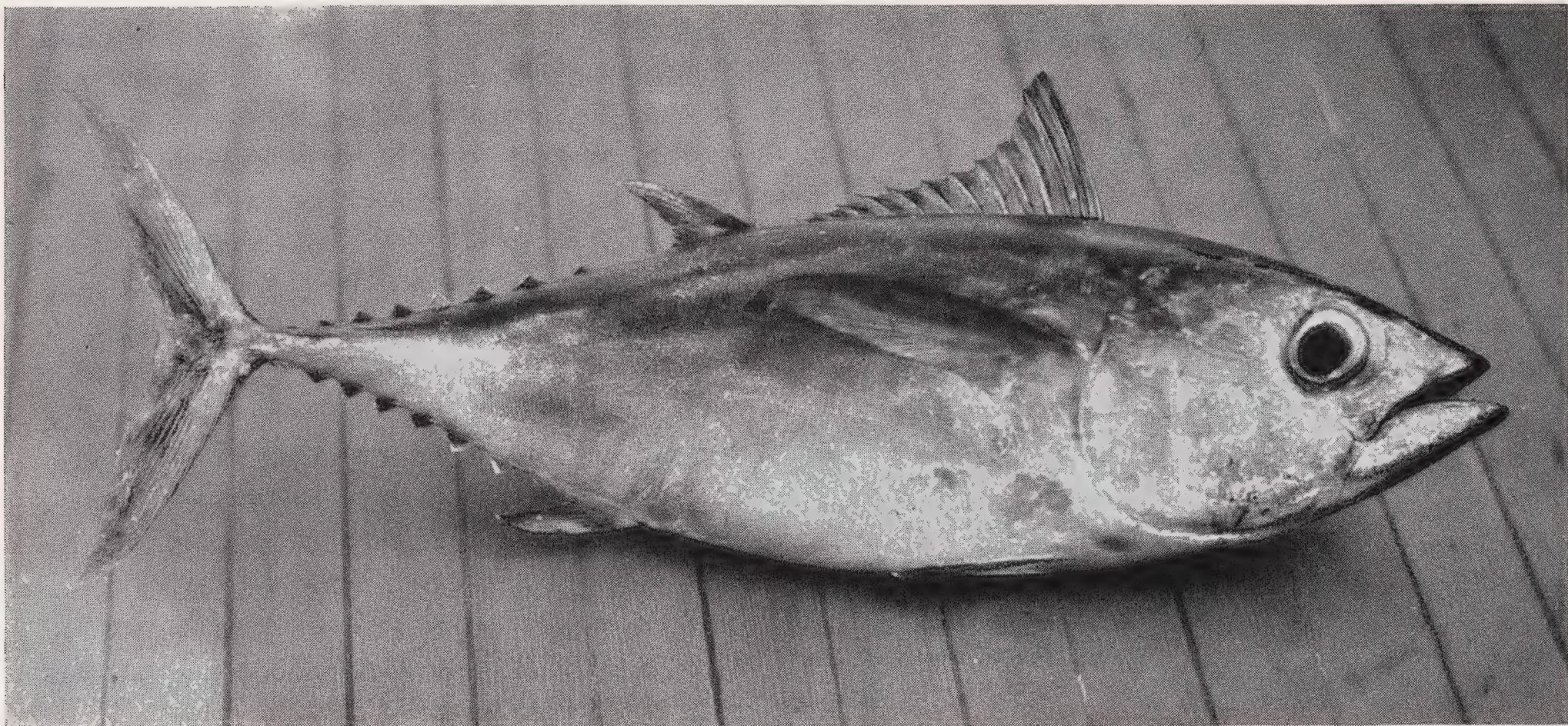
Leaving at midnight we made Saba at ten the next morning. It was too rough to attempt a landing, and all I could do was to blow three blasts on our whistles which echoed back and forth among the great mountains. Soon a row of tiny dots appeared on the rim with waving handkerchiefs; old friends from the spic-and-span little town of Bottom, forever invisible to the outside world except to passengers in the Pan-American planes which pass directly over the diminutive island.

The grand panorama of islands passed before us all day—also old friends of nearly thirty years' acquaintanceship—St. Martin, St. Bartholemew, 'Statius, St. Kitts, Nevis, Montserrat and Guadeloupe, with Antigua and Barbados just below the horizon.

Martinique was quiet and decorous after our last visit, which occurred on the *quatorze juillet*, but there is always a surprise in Martinique. Sunday evening proved to be the very last day of the *Exposition Tricentenaire*, and even after fourteen months it was patronized by hundreds.



There were merry-go-rounds, dozens of little gaming tables, scores of small drinking booths, a thatched hut with wax-work Caribs watching a human arm cooking on a spit, dance halls, much worn cinemas and moth-eaten stuffed birds



The common black-finned tuna of Bermuda, Florida and the West Indies, Parathunnus atlanticus, is a stream-lined fighter which never gives up until it has been hauled into the boat. A three-foot specimen is considered a very large one.

and animals. In the midst of this scientifically discouraging environment, we found an excellent exhibit of rare fresh-water fish and talked ichthyology with a French *avocat* in a booth with the engaging name of "Votre Agréable Coin."

The fish market next day yielded many things of interest and then we motored through the giant forest of tree-ferns, down the slope of Mont Pelée, to slowly resurrecting St. Pierre, in whose market fish on their slabs, even now, soon become dusty with volcanic ash.

We found huge tunas being cut up and sold, and astonished the natives by taking measurements of the relics and purchasing the gills and stomachs instead of the delicious pink flesh.

But it was not until we reached St. Lucia three hours away that we were able satisfactorily to study these giant fish. Here we found both black and yellow-finned species in the market and later intercepted the incoming fishing boats and purchased their catches.

At last we were able to measure and examine these magnificent fish which for so many years have been caught here and elsewhere and named on most superficial characters. Our results will be published in forthcoming numbers of *ZOOLOGICA*, so I need here mention but a single typical experience. Fishermen had been warned that if they stopped at the yacht

anchored off Castries they might be able to dispose of their fish. The first boat in from the fishing grounds lowered her sail and tied up at the gangway. Wedged into the narrow boat was a big yellow-fin tuna. I bargained for it and we finally agreed on four pence a pound. We got it on deck, and although it was of moderate size as these fish go, it weighed over 140 pounds.

We usually think of swiftness and speed as correlated with a slender elongate body. Yet these tunas appear actually fat—full, rounded spindles of silver, bronze and gold, tapering rapidly fore and aft. The fins sink down into cunningly contrived grooves, and the fish merits the term "stream-lined" far more than any vehicle of man's invention. The dorsal and ventral fins are necessary for balancing, and on the peduncle of the tail are two additional fleshy keels. The tuna is really a great propulsive engine, the boilers and shaft being the mighty lateral bands of muscle, which impart power to the wide-spreading lobes of the crescent tail.

Even out of the water these fish are very beautiful in coloring, bluish-black above, changing into iridescent steel blue shot with gold along the sides and gleaming silvery below. Always the finlets are rich chrome yellow, and this character, together with the long, curving fin lobes, sets this species apart.

The capture of these fish is dramatic in the extreme. From our anchorage we could distinguish the white caps of the open sea, and we vividly remembered the pitching and tossing which the *Hardi* had endured during the three hours' passage from Martinique. Yet at this moment we could see two more tuna fishers entering the harbor, their sails fluttering like butterflies and their hulls quite invisible in the foam of the waves.

Two men set out and spend two days in the channel between the islands, perhaps twenty miles from shore, trying to hook a giant tuna with flyingfish as bait. Their boats are frail, narrow and cranky as canoes, with sharp, forward-projecting bow keels. Why the first rush of the fish does not overturn the craft, I do not know. They can only tire out the fish by letting it tow them about; yet they dare not let it sink and die for it would be impossible to bring up and the sharks would take it. When the maximum of two are wedged somehow into the boat, there is no room left for the men themselves except on top.

Think of the decisions the fishermen are often called upon to make: a great fish on the hook, the line rushing out perilously near the end; snubbing impossible because of the waves in the face of a rising storm; cutting the line meaning the cruel loss, not only of the fish but of hook and line—all precious; not cutting it being a desperate gamble with life itself at stake. No wonder they had little of the light laughter of the shore negroes; no wonder their faces were seamed with deep lines of worry. We were not surprised when we heard of boat after boat vanishing during the season, of man upon man reported missing.

The satisfaction we gained was that these large yellow-finned tuna fitted into the series which we had built up in Bermuda and elsewhere, and all the confusion of names which had been applied to individual fish began to clarify, and there emerged as the rightful appellation that given by Baron Cuvier one hundred and five years ago—*Neothunnus argente vittatus*.

Union Island, the loveliest of the Grenadines, proved in February to be very different from what I had found it in June, and we experienced nothing but rough, trade-wind weather, while all fish had vanished into deep water.

With a brief stop at Grenada we went on until we reached our second objective.

The early dawn of Sunday, February 9, was one of those rare, perfect syntheses of sea, sky, temperature and calm when time itself seems to stand still. The full silver moon was dominant in one half of the heavens, and the sun's rays were creeping over the Tobagan coast. The distant mountains of Trinidad rose high and purple in the south. There was a slow, deep swell with the surface like a mirror. Large flyingfish rose by the dozen in the increasing light. Their tail propellers were a complete blur when they taxied into flight, but when we passed, every caudal flick could still be counted from the widening circle of scores upon scores of ripples left by the distant fin.

In the course of the next nine days we learned to know and love Tobago, encircling it slowly, anchoring in such grandly named bays as Rockly, Prince's, King's, Tyrrel, Man-o'-War, Pirates', Dead Man's, Bloody and Buccoo.

During the past nineteen days we had steamed nearly fourteen hundred miles through



Fishermen of St. Lucia risk death in these keeled dug-outs, catching giant tunas in heavy seas far from land.



In Man-o'-War Bay in Tobago, all the natives are fishermen. At the time when the "Hardi Biaou" party visited the island near the end of the northern winter, all the mountain slopes were ablaze with the orange flames of the bois immortelle.

the great crescent of the West Indies, becoming familiar with the birds, lizards, butterflies and fish which differed only slightly from island to island. Now we had reached Tobago, only seventy miles south of Grenada, yet within an hour's walk on shore I saw fifteen species of birds only one of which was to be found on any island to the north. Here were no todies or palm chats, or birds hinting of North or Central American derivation, but such tropical forms as motmots, jacamars, manakins, blue tanagers, caciques and antbirds. It was the most abrupt and dramatic change of fauna I have ever experienced.

Within a week we caught and identified 130 species of fish, and while naturally the new element in aquatic life was not nearly so radical as that of the land, yet the change from West

Indian fish was distinct and intensely interesting. Our tuna researches thrived and we were able to secure and study 22 of the black-finned species, *Parathunnus atlanticus*.

Tobago, fortunately, is out of all regular steamer routes, served only by a small but comfortable coastwise vessel which plies back and forth from Trinidad. In almost every bay a delightful English couple had their bungalow perched high on the mountain slope overlooking the water. As we encircled the island I found everywhere keen interest in my work and a desire to help.

The lush tropical beauty of Tobago, the golden glory of the innumerable bois immortelle trees illuminating whole mountain sides, the coral reefs showing through clear waters, the great morpho butterflies, the creatures of

jungle and of sea, and finally the incredibly lovely birds of paradise on Little Tobago—these must have treatment by themselves. Suffice it to say that in Tobago we found a new and unspoiled land, abounding in Neotropical life on land and in the water, where six months of research would unearth a gold mine of new scientific facts and life histories.

Trinidad was almost like returning to one's home, thanks to the hospitality of old friends such as Urich, Guppy, Potter, Buck. The sights, sounds and smells of the true tropics, the remaining stands of primeval jungle, the strange pitch lake, the hosts of East Indians, make it a place of unique charm. To northern visitors it must always be a foreign of foreign countries. Our stay was too short both in Trinidad, La Guaira and Caracas, although our visit to the latter place was leavened with the excitement of political upheaval.

Margarita and Curaçao offered as great antitheses as was possible for neighboring islands. I had always wanted to visit them as examples of isolated lands with species perhaps peculiar

to them. Margarita is a province of Venezuela, only a few miles off the coast, consisting of two mountains of red shale separated by a ten-mile sandy peninsula. We anchored off a comic little town with a Spanish castle, a *duana* and some adobe huts, and it seemed quite right somehow that its name should be Pampatar. About a dozen Venezueulans came off, among whom, judging by their insignia, were three lieutenant generals.

We walked down the single street of Pampatar and as we went, like a swarm of flies, a gang or school or herd of gamins attached themselves to us. They were not unpleasant, only they simply occupied all the nearby landscape and would not be persuaded to leave. If I leaned over and picked up a shell a score of broken mollusks was thrust at me; if I caught a tiger beetle the air was filled with out-stretched grimy hands presenting cicindellid débris.

We left the shore and struck across a tremendous plain, flat and hard as a ballroom floor. We walked for a mile across it attended by our comet's tail of *niños*. Every five or ten minutes



The famous pitch lake of Trinidad is a rich collecting ground for guppies and other small fresh-water fish. They do not seem to mind even when bubbles of hydrosulphuric acid gas escape from the bottom of the shallow pools in which they live.



F. W. Urich is one of the best-loved of West Indian naturalists, a complete benevolent institution in himself.

they would set up a strange weird chanting, or rather howling, on a few long-sustained notes lacking rhythm or intervals. It had the same quality of wildness which pervades the yells of savages and is almost never heard in corresponding vocal outbursts of more civilized peoples.

The whole world of Margarita was a dry, dead world. At the end of the plain, continuing through a narrow pass between two hills, we came upon a great salt lake which looked like pale blue ice surrounded by a frosted rim. It proved to be muddy, and the salt crystals crackled under foot like frozen peat. Beyond was the sea with six lines of enormous breakers. Up and up we climbed along a narrow trail bounded by impenetrable thickets of cactus,

mesquite and aromatic-leaved plants. The strangest of all was a low, leafless growth of twigs looking like a very badly made contrivance of rubber and gray paper.

I sat down on the highest point where a wonderful view stretched out in every direction. Vultures at once swooped past to ascertain whether I was prospective provender. Man-o'-war birds followed the vultures out of curiosity, drifting close overhead, regardless of gravity as falling leaves, yet exquisite masters of the air as only these birds can be. Then the vultures saw the man-o'-wars examining us, thought they had overlooked some hopeful symptom of threatened decease, and returned, and for a half hour we were the center of a score of interlacing forms—black, white, scarlet—floating, diving, rebounding from the invisible solidity of air. Steel-blue wasps hummed about with wings more brilliant than the infrequent butterflies. The whole world seemed barren and gray even to a hummingbird which hung before me clad in dusty gray-green. But as I looked closer I began to see minute points of relief. Half hidden in the tops of barrel cacti were small flowers, brighter scarlet than I knew existed, and from first one then the other side of the slope three golden troupials blazed into view. Mockingbirds sang under their breath and a wren's song was as liquid and bubbling as if it had just found the last drop of sweet water in this parched land. In two hours of a twenty-fifth of February I came to know much of the wild life of Margarita.

On my return I clambered down the mountain side into the back yards of Pampatar. I should have said around the yards, since, long before, the owners had marked out their plots with bits of cactus pushed into the ground, all of which had sprouted and grown into such a barrier that nothing but a knight in armor could have passed through. Yet there were no burros or fowl, no vegetables or flowers to be cribbed and confined. The fences were visible marks of possession, symbolic but quite useless. Every hut had the same accessories—a bedraggled woman and a tangle of children on the mud floor, a roofful of vultures and a great pile of the most beautiful pearl shells drifted like snow against the house. Here were dire poverty and beauty in closest juxtaposition, and I remembered that this island had once been so famed



(Upper). Sprouting from sheer sand in the dry air of arid Margarita grow strange, unreal plants with thick, swollen and leafless stems. This is *Jatropha gossypifolia*. The squalor of human life and the hungry vultures of Pampatar contrasted with the high piles of beautiful mother-of-pearl shells drifted along the beach.

for pearl-fishing that it took its very name from the shells.

Before we left, an unspeakably filthy old man shambled up to me and unwrapping a dirty bit of newspaper displayed several minute, equally dirty and wholly valueless pearls for my consideration. Browning's lines seemed to have no meaning for any native of this Caribbean Island:

"There are two moments in a diver's life:
One, when a beggar, he prepares to plunge;
Then, when a prince, he rises with his pearl."

These folk looked as if they had done all their diving by proxy, if at all. The memory of the people of Margarita was one of poverty, dirt and utter shiftlessness, with life sustained by the occasional finding of one of the most beautiful of ornaments.

Curaçao, on the other hand, seemed redolent of soap and water almost before we landed. At the entrance of the canal through Willemstadt the pontoon bridge of boats swung mysteriously out of our path and we steamed far into the lagoon heart of the island. Later we were to confirm our impression of cleanliness of the city, and to find even the fish market scrubbed and shining. But as we passed out of sight of the metropolis into the interior and anchored, we became aware of a most unpleasant odor, and from that moment we sniffed, saw and too often touched crude oil. In ten great tankers which plied between Curaçao and Venezuela each day Dutch merchants brought uncounted tons of oil, poured it into (and occasionally spilled it over) refining machinery, sold it at a goodly profit and, purchasing soap and water, furbished up the streets and houses of Willemstadt!

Eager to see something of the wild life, two of us put off in a rowboat to the cleanest, which was the most distant, shore. Before we landed all waves and ripples ceased; there was only a horrid lift and settling of the black fluid. The tidal area was a terrible sight, a cameo of dead coral heads silhouetted in jet veneer. We landed and worked our way painfully through thorn scrub to the nearest ridge. No bird, lizard, butterfly or other sign of life appeared although at this height the only indication of the oil-land spread out below was the strong, unpleasant odor.

After we searched here and there, it occurred to me that this was an extremely interesting con-

dition of affairs, and that the presence of any form of life in this vicinity would argue a tremendous power of resistance to a new, insidious factor which dominated the whole of the environment edging the lagoon. So we settled down to a careful, thorough search of the ridge and slopes. After uprooting a host of dry plants and turning over several hundred stones we returned and made a list of our discoveries.

It must be understood of course that away from the oleaginous lagoon, Curaçao birds and insects are as abundant as on any of these semiarid Caribbean islands, but in this spot we found a forlorn hope fighting for existence against devastating odds.

A single dove flew past, the only bird we saw, and she seemed bent on getting as far away as quickly as possible, and it is with reluctance that I refrain from making a pun about Noah's Ark olive oil. On the ground were literally tens of thousands of dead and whitened cerion snail shells. With a single scoop of my hand I gathered sixty-four. Near the summit of the ridge three of these snails were hibernating, clinging with sealed openings to dead twigs. A single robber fly was captured and one very small ant seen, while two equally minute and lethargic beetles were huddled under a root. One three-inch scorpion, pale buff and very active, lived near three small green centipedes, all under stones, while three small skinks which were seen made their escape. One of them, however, left behind a complete shed skin which identified them as *Gymnophthalmus lineatus*, a rare species and new to this island. These little lizards were exceedingly active and darted beneath stones and brush the moment they were uncovered. They were dark brown with a broad, pale buff stripe down each side from head to tail, the tip of the tail being vermilion red.

Small brown lizards, *Gymnodactylus antillensis*, were the only even relatively common forms of life, for I caught five and saw eight others. Unless I seized these diminutive reptiles by the body, the tail pulled off very easily and did a mad dance of death by itself. Unlike the skinks these lizards showed no fear and waited quietly watching me when I lifted their roof. The males were smaller than the females, dark seal-brown, paling into yellowish-green on the head, with the throat clear yellow. In the female the whitish throat was heavily mottled with dark pigment. In their search for food

they had had much the same success as I in my collecting, as I found the legs of small scorpions, a fly and a few ants in their stomachs.

Comparison of Margarita with Curaçao is obvious; poverty and shiftlessness in the one, with fortuitous pearls as the precarious basis of existence; thrift and cleanliness in the other, maintained by manipulating a substance which defiles land and sea. This point of view, I must admit, is rather one for the dramatist or poet than for consideration by the political economist.

Our experiences in Jamaica and Cuba would each fill a chapter, and the scientific results will soon be forthcoming, but our visit to Gun Cay outside of Kingston Harbor will answer for the present. We planned to explore the coral reefs about Port Royal with helmet and hose in spite of the usual doleful warnings about sharks and sting rays, but after covering a good deal of ground with glass-bottomed boat and water glass, we saw little of interest except

tangles and jungles of broken and dead branch coral. In despair we jumped overboard near a tiny islet named Gun Cay and waded ashore. Although the water was only two to four feet deep, the bottom had all the characteristics of a coral reef five to eight fathoms down; large branches of elk-horn, rounded heads of brain coral, and many others all alive. Sea-fans, sponges, gorgonias and waving algae were everywhere, among which swam schools of fry, surgeons, demoiselles, lizardfish, parrots and a score of others. We got excellent photographs through the water glass of fish and corals and if time had permitted could have assembled in visualized form representatives of almost every group of coral reef life. I have never anywhere seen such a healthy, well developed reef so alive and growing, yet located where one can wade comfortably about and, through the water glass, study the habits and inter-relationships of the various organisms. Elsewhere, as in Bermuda, Bahamas, Haiti and



The odor of crude oil has blasted the shores of the inland lagoon of the Dutch island of Curaçao and a careful search under stones and plants disclosed only a few centipedes, scorpions and lizards that had managed to withstand the fumes.

Tobago, to see similar things within arm's reach it is necessary to make trip after trip down in the diving helmet.

The days at sea en route to the Isle of Pines and later from Havana to Jacksonville were so calm that we made full use of the pulpit all day and the submarine light at night. Slender-tailed lanternfish came to the light, always a surprise to me, as their whole life is spent avoiding the sun, descending at dawn and rising in the night. One among many strange happenings was the appearance of what looked like a double fish, but proved to be a flyingfish floating with outstretched wings upon the surface, with a second fish half-sheltering beneath the large ventral fins. I caught both and the fish which had sought sanctuary in such a strange position proved to be a young dolphin.

I never knew the Gulf Stream to carry a richer load of life upon its surface. There were Portuguese men-o'-war, and the related veellas and porpitas, heads of sargassum and drifting bamboo. Beneath all these swam fleets of young fish, gay as butterflies, trusting im-

plicitly for protection to the thin shadow of the siphonophores, the fronds and floating sticks or the pulsating umbrellas of the jellies.

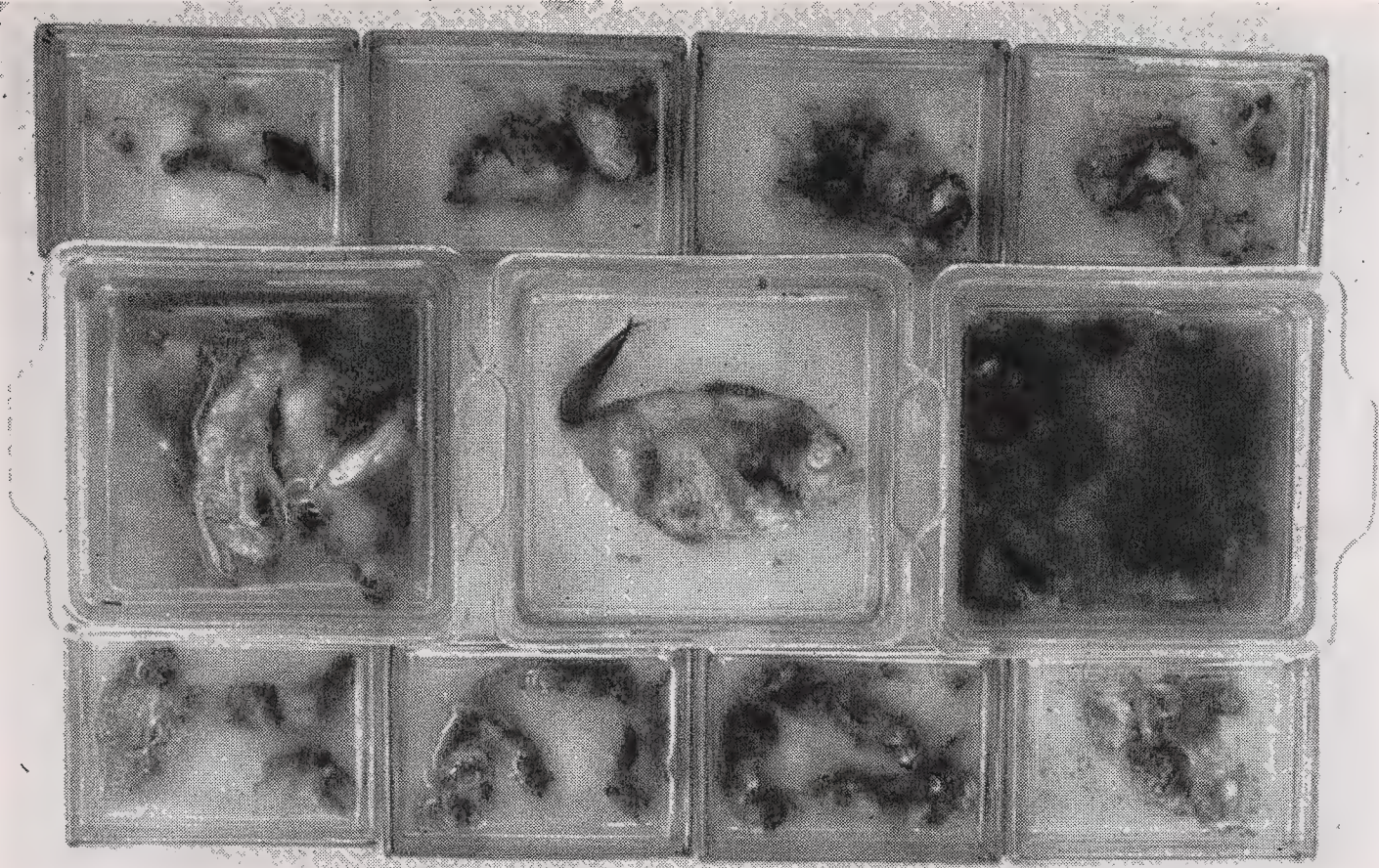
On the last day, with the last sweep of the net I brought up a small physalia together with a single fish, which proved to be the rarest we had taken on the entire expedition. It was a young snipefish, a cousin to trumpet- cornet- and pipefish. The same or a nearly related species is found in the Mediterranean, and eighty years ago one was taken at Provincetown. There are two more records for the Atlantic Coast which are all that have been found in this part of the world until I snatched my inch-and-a-half *Macrorhamphosus* so rudely from his shelter beneath the keel of the floating man-o'-war.

PART II ICHTHYOMANCY

The selection of the study of tuna as one of the major objects of our most recent trip to the West Indies came about in an interesting way. Until a few years ago the presence



One of the wildest places entered during the expedition was the mangrove jungle of Los Cayes de los Indios off the south shore of Cuba. Dense clouds of mosquitoes guarded this home of cormorants, pelicans, limpkins, egrets, sharks and barracudas.

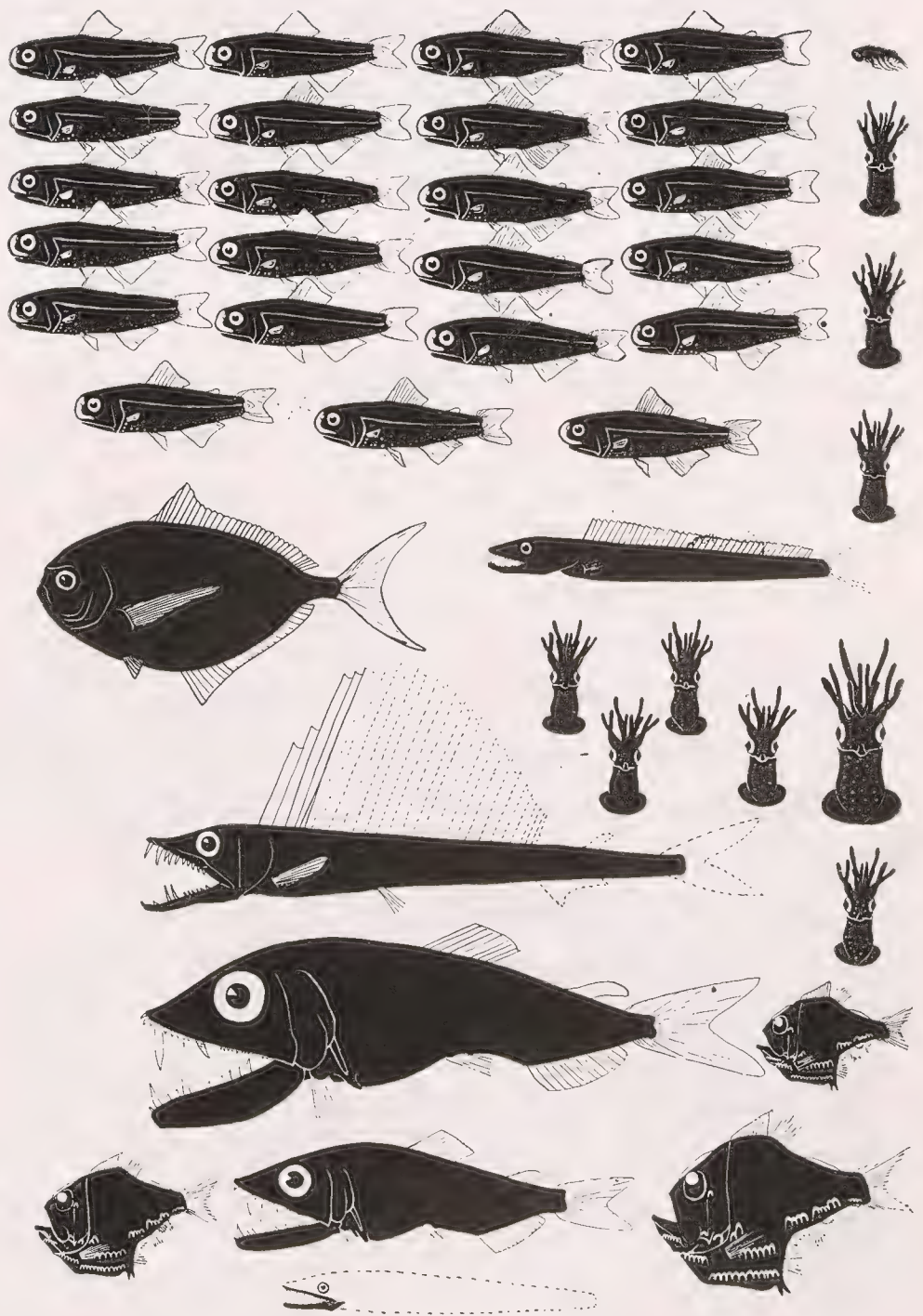


At the left is shown the food of a sixteen-pound male black-finned tuna, *Parathunnus atlanticus*, caught at the surface off Nonsuch Island, Bermuda, on August 7, 1935. Both the fish and the invertebrates are deep-sea forms, relatively fresh and quite recognizable.

of tuna in Bermuda was quite unsuspected, whereas hundreds are now caught every season. As an important addition to the fish fauna of these islands, this was of great interest to us and we began to assemble as many specimens and as much data as possible. We found that even the rightful name was in question, that almost no habits were known and no direct comparison had ever been made with the tuna of the West Indies.

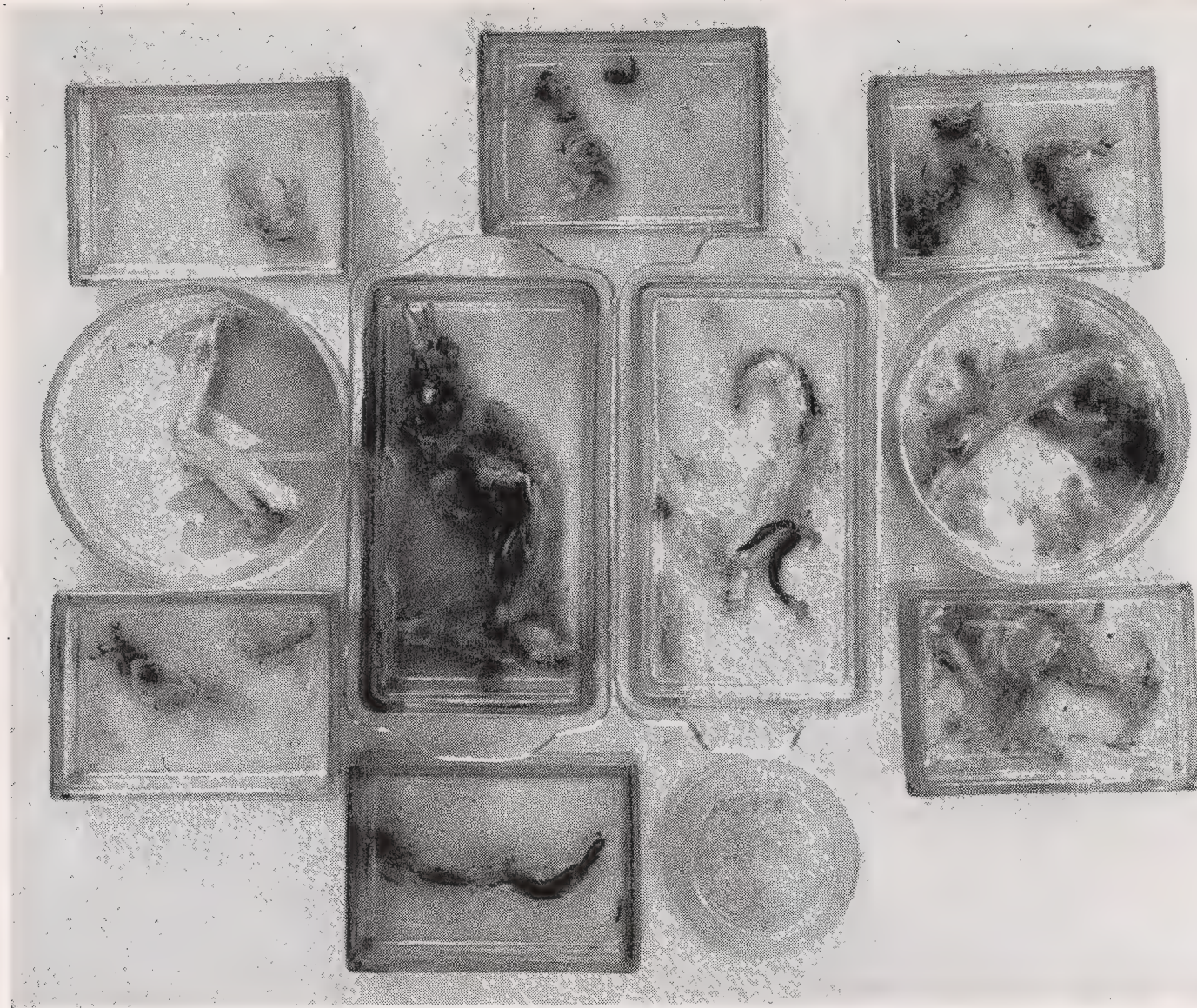
The first examination of the food of these fish made us apostles of Ichthyomancy. This was an obscure pagan practice in olden times of divination by the heads and entrails of fish. Substituting the food of tunas for the other sacred objects we made amazing discoveries in Bermuda; we found rare or absolutely new species of fish and of invertebrates, we could reconstruct the fish fauna of places so obstructed with coral reefs that neither net nor dredge could be used, we could state with accuracy to what depths the tuna had been, and whether several fish had been associated or were swimming and feeding by themselves.

One example must suffice. On August 7, 1935, Mr. Christianson brought us two tuna, caught, almost simultaneously, three miles southeast of Nonsuch Island, Bermuda. Tuna are so often seen and taken in pairs that it appears reasonable to assume a definite relation between the two. In this case the male weighed sixteen pounds and the female twelve. They were typical black-finned tuna, *Parathunnus atlanticus*.



This is a restoration of the deep-sea fish food shown above. It represents 23 effulgent lanternfish, 1 *Brama raii*, 1 short-toothed gempylid, 1 *alepisaurus* sail-fin, 2 *Omosudis lowi*, 3 silver hatchetfish, 1 unnamed triangle-toothed fish, 1 hyperid amphipod, 9 luminous squid.

(Drawing by George Swanson).



These dishes contain the food of a twelve-pound female black-finned tuna taken at the same time and place as the male whose food is shown on Page 139. (Below). Restoration: 1 saw-toothed gempylid, 2 Benthodesmus atlanticus, 2 short-toothed gempylids, 5 specimens of a new Paralepis, 3 Rafinesque lantern-fish, 3 luminous squids, 51 squilla larvae.

(Drawing by George Swanson).

Although they were caught at the surface with white feather jigs, the first glance at the food showed that very recently they had been feeding at great depths. The food was quite fresh and the tuna must have come to the surface with a rush and immediately seized the feather jigs, far from their zone of feeding, as one takes after-dinner coffee in the drawing-room. Between them these tuna had eaten thirty deep-sea fish, some new to science, others exceedingly rare, and several of world's record size. In addition they had swallowed a dozen luminous squid and more than sixty other creatures of the black abysses. The light organs of all these were plainly visible, together with the typical scarlet and black coloration of inhabitants of these sunless depths. None of these hundred-odd organisms would ever, of its own will, have arisen even into the dimly lighted regions of mid-water. The average depth at which they thrive, and must have been caught and devoured, is more than half a mile below the surface.

I submit photographs of the contents of these two stomachs, and opposite each, the accurate restoration of the items of diet. On the first plate, among others, we see at the top twenty-three lanternfish, then an oval-bodied Pomfret or *Brama*, and a fierce dragon-like *Alepisaurus*



or lancetfish with a gigantic sail fin. Next come two sabre-toothed *Omosudis*, the larger a world's record for size. Near the bottom are

three silver hatchetfish and scattered about we count nine squid covered with luminous organs of various colors.

The second plate of reconstructions shows what the female tuna had for dinner on this particular August 7, and proves that she must have eaten at the same level and time as her mate. Only she had taken fewer helpings of lanternfish and shown a greater partiality for the young of certain abyssal lobster-like crustaceans. She too had devoured exceedingly rare deep-sea fish, including five individuals of a new species of *Paralepis* or ocean pikelet, and two species of gempylids.

Most interesting of all were two representatives (the second and third from the top of the plate) of trichiurids or cutlassfishes, a family wholly new to Bermuda which we have never taken in any of our fifteen hundred nets.

The name of this fish, brought to us from a great depth in excellent condition by our lady tuna, is *Benthodesmus atlanticus*.

The stomachs of tunas are being saved for us by many kind friends in Bermuda and when we make our final résumé of the results we will have added considerably to our knowledge not only of the habits of these splendid gamefish but to the life histories of many other inhabitants of the sea. For us to do this successfully the objects of attack must be pursued and captured by the tuna, swallowed entire, and then the fish itself must ascend rapidly and almost immediately be caught on a trolling line, preserved and brought to my laboratory. Is it any wonder, when this adventitious concatenation of events happens within our experience dozens of times, that we count ourselves most favored disciples of Ichthyomancy?

A Moose Herd Is Moved

Michigan Transfers Thirty-eight Animals from Isle Royale to the Upper Peninsula Mainland as a Conservation Measure

BEN EAST

Nature Editor, Grand Rapids Press

"A CHARGING moose," Paul Hickie told me once, "can cover ten yards while you're covering ten feet. I tripped and fell on snowshoes ahead of an old cow, in the timber back of Holger Johnson's cabin, and the only thing I can remember thinking as she rushed past me was how she got there so blamed quick."

After which Paul added the quiet declaration that when you see the hair on a moose all stand the wrong way it's time to yield the trail. Hickie spent the winter of 1934-35 on Isle Royale, in upper Lake Superior, in charge of an experimental moose live-trapping project for the Michigan Department of Conservation. He probably knows as much about moose behavior, both inside and outside a corral, as any man living.

Dick Lahti, the Michigan conservation officer who cruises Isle Royale each summer in command of Patrol No. 4, a small state boat, declares that the only time he ever slid up a tree

was when a truculent bull moose charged him in the Todds Cove district of the island.

Dick picked his tree when he saw the moose coming and realized it meant business, he relates. The tree was a birch with a low branch. He grabbed the branch but it was dead, and broke, dumping him in a heap at the foot of the tree.

"I've slid down lots of trees," Dick tells the story, "but I slid up that one. The birch bark fairly smoked behind me, and at that I wasn't up any too soon."

I remembered Hickie's and Lahti's statements as I stood there in the moose corral on Siskiwit Bay and faced the sullen, crafty old bull that was slowly circling toward me from the center of the enclosure.

As he walked deliberately my way I edged back nearer to the stout corral fence of birch poles wired to living trees. He was about twenty-five feet away and I was no more than five feet from the fence when his head went down, a sullen roar rumbling in his throat and the coarse

The photographs accompanying this article were taken by the author.



As the moose were trapped, they were turned into a large corral made of birch poles wired to living trees.

hair bristling across his shoulders, and he came at me. I went under the lowest fence pole in a standing dive. Some of the other members of the crew maintained I would have gone much farther if I had not slid into a couple of trees as I scrambled up on the other side. Maybe they were right. For my part I am certain only of one thing. When I gained my knees outside the fence and looked back over my shoulder the moose was at the barrier. Like Hickie, I wondered how he managed to get there so fast.

We were not baiting him for fun and I had not entered the corral as a lark.

He was the last lone bull remaining, of more than fifty moose live-trapped on Isle Royale this last winter for transplanting to the mainland of the Upper Peninsula of Michigan.

Down at the dock on Siskiwit Bay twelve crated moose, the last boatload of the captive herd, waited transfer aboard the *Elmar II*, swinging at anchor a quarter mile offshore. We had begun the work of crating the last load that

St. Germain soon had the animals feeding from his hands as they became accustomed to life in the big, roomy corral.



Generous rations were provided in the feed racks and the half-starved moose fed well for the first time in many months.



morning at six o'clock. It was now past supper time. It was necessary that we handle the old bull as quickly as possible, wind up the job and start the seven-hour cruise to the mainland.

We had gone into the corral, John Underwood and I, in the hope of driving the bull into the traps, whence he could be moved into his crate. But Hickie had told us, long before, that a moose won't be driven, and we were proving it now to our own complete satisfaction.

We re-entered the corral and in less than five

seconds I repeated my dive under the fence. I was getting faster with practice, too. When the bull turned on Underwood and sent him scrambling to join me outside we gave up that method of driving.

Six of us next went into the corral at different points, armed with empty syrup pails and short sticks, beating the pails like drums and yelling at the top of our voices. The moose fled from the racket, circled once and drove two of the crew over the fence, fled again and went racing



The healthier animals were able to regain their strength by heavy feeding, but many were too weak to survive the winter.



For several weeks in advance of the transfer to the mainland, the captive moose were fed in baited crates so that they entered them readily enough when the herd was prepared for shipment.

This sturdy bull fed readily from the hands of the crew in the Siskiwit Bay corral but it was quite another matter when they tried to force him into a crate on "moving day."



for the open traps at the lower end of the corral.

Two men waited on top of the traps, holding ropes attached to the heavy drop doors. They let go the ropes as he entered the nearer trap but he smashed straight through, caught the door on his shoulders as it fell and crushed it aside to go raging down into a second corral where earlier in the day we had isolated a cow and her newborn calf.

In the excitement that followed someone dived under the fence, grabbed the calf and carried it out to safety. Seeking escape from the commo-

tion, the cow trotted into the second trap and was caught.

By the time we finished crating her darkness was at hand and no one had the courage or the foolhardiness to re-enter the corral and try driving the bull again. We left him there to be released or shipped later, the one member of the captive moose herd that had proved difficult to handle, and we went about the task of loading the *Elmar* with her queer cargo.

The Isle Royale moose trapping project is the most interesting big game management un-

dertaking ever attempted by the Michigan Conservation Department, and one of the most unusual ever tried anywhere in the country.¹

It really goes back to March of 1934 when short-wave radio reports from Holger Johnson, an Isle Royale fisherman wintering in the complete isolation of the island, brought word that the moose herd for which Isle Royale had long been famous was dying off by the hundreds as a result of a shortage of winter browse.

Investigation revealed that the reports were true.

The moose had reached Isle Royale from Canada about 1912, established themselves, found food of all sorts abundant, and thrived until they had become probably the most heavily concentrated herd in the United States. In 1929 Dr. Adolph Murie, of the University of Michigan, estimated that the herd contained at least one thousand animals, perhaps two or three times as many as that, roaming a lake-limited range of 205 square miles.

Signs of over-browsing were then becoming plainly apparent, and the inevitable finally occurred. The radio messages sent out by Johnson, distressing as they were, brought no surprise to Michigan game men who had watched the situation with growing apprehension.

In the fall of 1934 the State Conservation Department decided to try a small live-trapping project, largely as an experiment to test the feasibility of capturing and transferring moose.

Hickie and one assistant, Ellsworth St. Germain, spent the winter at the Johnson cabin on Chippewa Harbor. They trapped a total of eighteen moose with a loss of only one, and eleven were moved to the mainland in spring.

Encouraged by the results of the experimental work, the Conservation Department decided to undertake the broad-scale trapping project carried out on the island this last winter, partially to thin the herd a bit as a step toward reducing the losses by hunger, but more in the interests of a larger planting on the mainland, where it was hoped the moose would establish themselves as resident game animals.

Since Isle Royale is destined to become a National Park, conservation officials sought the sanction of the National Park Service on the trapping operations, asking permission to cap-

ture and move to the mainland not to exceed one hundred moose, although game men hardly expect to reach a goal as high as that.

The permission was granted readily at Washington and plans for the project were completed.

St. Germain went back to Isle Royale in October to take charge of the work. With him went a four-man crew and a team of horses to do the hauling. Traps, corrals and a cabin for the crew had been built by enrollees from a CCC camp that operated on Isle Royale last summer.

Contrary to the experience of the first winter, the work went none too well.

Bad luck dogged the operations from the beginning. Of the first twelve moose trapped,



The "moose-plow" was the one device that would urge a reluctant moose into a crate when the food lure failed.

early in the fall, seven died. For a time bulls heavily outnumbered cows among the captured animals and it appeared that not enough cows would be taken to make the mainland planting worth while. Trapping proved difficult during

¹ For an account of the Isle Royale moose herd and its decline, see Mr. East's article in the March-April, 1936, number of the *Bulletin*.

the winter as a result of pulpwood logging operations that provided the moose considerable food outside the traps.

As spring approached more animals died in the corrals, for no apparent reason. Later examination by Dr. Don Coburn, animal pathologist of the department, revealed, however, that these were moose in bad condition, the result of slow starvation before they were trapped. Un-

reason to fear that the condition of many of the animals that do remain is precarious, and that the annual calf crop has fallen to a dangerously low level as a result of the inroads made by hunger.

A short time before the transfer of the captive herd to the mainland was due to get under way, bad luck struck another blow. A few of the moose had inflicted minor injuries on their



Once safely caged in a crate padded with old tire casings, the moose were hauled down to the shore for loading on the steamer.

dernourished, in many cases anemic, showing evidence of pneumonia and other disease, they had been unable to regain their strength on the generous rations allotted to them in the corrals, unable to win back sufficient of their dwindling vitality to carry them through the winter.

On the basis of what Dr. Coburn learned from the gaunt carcasses of those dead moose, drained of every last vestige of fat, even in the marrow of the bones, it is safe to say that the Isle Royale herd has taken a terrific beating both as to numbers and condition between the summer of 1935 and the present time.

Game men will make no estimates of the size of the herd remaining, have in fact no complete or accurate basis for such estimates. But on the basis of casual observations, those who have known the moose of Isle Royale since the days of their peak abundance voice private doubts whether more than 10 to 20 per cent. of the original herd remains today—and there is grave

“heels,” the hind leg joints, as a result of kicking in the traps or crates.

One by one these animals began to go lame, to show signs of infection in the heel joint. One by one they grew sicker and one by one they died, although none of the injuries was more serious than a minor scratch or a barked knuckle on a human hand.

Later Dr. Coburn solved this riddle as well. The same “bug” that causes foot-rot in domestic sheep had found its way into the cuts and bruises on the moose, had attacked the great heel tendon and turned the entire area of the joint into a green, putrid mass. And finally these tiny “bugs” succeeded in actually eating through the tendon, ham-stringing the moose as surely but not as quickly as the clipping fangs of any timber wolf. And then the sick moose went down and could not get up again, and then he died.

Oh, it was discouraging work at times, all

right, for St. Germain and his little crew, and for Hickie and other game officials who received week by week from the winter isolation of Isle Royale the short-wave radio reports on the progress of the work.

But when the job was finished thirty-eight live moose were freed in three areas on the Upper Peninsula mainland—and that is something of an accomplishment, hard luck or no hard luck.

Two boatloads of the moose had been sent across Lake Superior when I reached the camp on Siskiwit Bay, aboard the *Elmar*, on the evening of May 15. Two days later the boat returned from a trip to Minnesota ports, ready to finish the moose job, and the crating of the last boatload got under way.

We had received word, in the meantime, that the stork had visited the corral at Chippewa Harbor, where trapping operations had been carried on during the latter part of the winter by Johnson under contract with the state, and where one lone cow remained to be shipped.

Dr. Coburn boarded the *Elmar* with one helper and started for Chippewa Harbor, to undertake the job of crating the mother and bringing her and the calf back to Siskiwit Bay while the rest of the party completed the work there.

St. Germain had paved the way for the crating of the animals in the Siskiwit Bay herd by feeding them for several weeks in crates placed

inside the corral. Of the fourteen remaining in the herd the first seven were lured into the baited crates with little difficulty, the doors dropped behind them and bolted in place.

By that time the crate doors had been heavily padded with strips of old tire casings, to prevent as far as possible further injuries to the legs of the moose. Softer padding material had been tried but nothing short of the old casings proved able to stand up under the savage kicking of the few moose that really fought the crates.

At noon, with six bulls and one cow remaining to be handled, the stork intervened, presenting the cow with an ungainly, spindly-legged calf. By careful work the bulls were moved out of the maternity corral and the cow and her youngster left to themselves.

By that time the dwindling herd was growing excited and wary and none of the bulls would enter the crates of their own accord.

No alternative remained but to work them, one or two at a time, down into the big drop-door traps at the lower end of the corral, and then force them into crates with the clumsy but efficient, wedge-shaped device developed by Hickie the year before and dubbed, for want of a better name, the moose-plow.

That required time, but it worked. One by one the bulls were herded into the traps and the doors dropped ahead of them and behind

Here at the dock on the shore of Siskiwit Bay the crates are awaiting the arrival of the steamer that will haul them to the mainland.



them by men standing in readiness on top. Then a crate was moved into place at one door, the opposite door was raised a few inches at a time to permit the plow to be shoved into the trap, and working behind it as behind a huge shield the crew crowded the resentful bulls into the crates.

At supper time but three moose remained, the cow and her young calf, and the solitary old bull that was destined to balk all our efforts at crating him. The last moose handled, made wary by solitude, is bound to be most suspicious, wild and sullen of the lot, and our failure to crate the final member of the herd was no great surprise.

It was two hours past midnight when we finished the back-breaking job of loading the crated animals on board the *Elmar*, and lashed the last crate in place for the crossing of Lake Superior.

When the boat hoisted anchor and started down Siskiwit Bay, under the pale ghostly banners of the northern lights, in her forward hold were the two moose calves, one three days old, the other no more than twelve hours. Their mothers were in crates on deck, taking things easy and behaving much more quietly than we had expected.

All of the party save one hurried below deck and tumbled into whatever bunks we could find, exhausted with the long, gruelling day. The one

exception was Dr. Coburn. He stayed awake to feed the two calves at regular intervals. A nipple left at the lumber camp on Isle Royale by the parents of a young baby that had wintered there was pressed into emergency service, and the young moose took to a diet of canned milk with evident relish.

Early the next morning the *Elmar* docked at Houghton and the moose were loaded onto trucks for the last leg of their journey to the Cusino Game Refuge, where they were to be released. On the way Dr. Coburn overhauled the truck caravan, halted it and fed the calves once more. Late that night they were reunited with their mothers, in stout corrals made ready for them at Cusino.

But the bad luck that had pursued the moose project from the start was not quite finished. The following noon the older calf was found dead in the corral, drowned in a shallow watering hole. He had fallen over a log, into water a foot or so deep, and lacked the strength to clamber out. He was one moose whose loss came near to breaking the hearts of the entire party.

Of the thirty-eight animals that reached the mainland safely and in apparent good condition, twenty-eight were sent to Cusino, six to the Escanaba River Game Refuge and four to a tract of wild land on the tip of the Keweenaw Peninsula, Michigan's nearest mainland point to Isle Royale.



While the two young moose were separated from their mothers on the trip, Dr. Coburn fed them regularly on canned milk and they took to it with relish.

Seven of the lot that went to the Cusino were held in corrals for experiments in feeding and breeding. Later they will probably be freed to join the others.

What will be the results of this novel colonizing experiment? Will the moose thrive, will they find conditions to their liking, will they in-

crease and spread as the original Isle Royale band did two decades ago?

No one knows, but plenty of good moose country awaits the new colonists, plenty of summer range, plenty of winter browse, plenty of lakes and swamps and hardwood ridges—and the hopes of Michigan game men are high!

Fishes We Don't Exhibit—and Why

For Several Good Reasons the Aquarium May Keep a Lungfish from Africa, but No Hammerhead Shark from Sandy Hook

C. M. BREDER, JR.

IN the past third of a century the BULLETIN has published many articles on fishes exhibited in the New York Aquarium and occasionally on fishes never exhibited anywhere alive. Accounts of these latter have increased in recent years since the Department of Tropical Research has turned its attention to fishes. Why are these fish not on exhibition? What is the Aquarium for, anyway, if it does not exhibit new fishes as they are discovered, or old ones that have general interest?

Frequently after the return of Dr. Beebe from an exploratory trip into the tropical seas visitors expect to see some of his bizarre deep-sea creatures disporting themselves in our tanks. Their disappointment is often keen—and vocal. Those creatures with eyes on stalks, with huge mouths, with rows of colored lights, were captured and brought to the surface. Well, why doesn't the Aquarium put them on exhibition?

Quite apart from the fact that the Department of Tropical Research expeditions are not collecting parties for the Aquarium, there are some very good reasons why their trophies cannot be presented alive to an eager and curious public, at least with the present equipment and ability of aquarists.

Equally good reasons exist for the gaps in our collections that might, one would think, be filled by some of the common but interesting fishes of our nearby surface waters. Surely everyone would like to inspect a hammerhead shark at close range. Why doesn't the Aquarium exhibit one?

But before going into details, let us look at some of the general reasons why it is possible

to exhibit one fish and not another. The fact that a certain fish may be found only in a far distant part of the world is not in itself an important consideration, of course, for it may be that its capture and exhibition simply depend on having sufficient funds to go after it and bring it back, and if funds are not available at one time, they may be at another.

Actually there is a surprising number of distant geographical points represented in the Aquarium collections, including Afghanistan, Borneo and East Africa. On the other hand, quite a number of fishes that are to be found in swarming thousands not twenty miles from Battery Park we have never been able to exhibit. There is no economic obstacle here, unless we concede that in some special cases sufficiently elaborate equipment might make the impossible an actuality.

No, the barrier between the Aquarium tanks and many deep-sea fishes, even many denizens of New York Bay, is one raised by the nature of the fishes themselves. The problem of coping with it is a double one:

First, can we capture and transport the fishes to the Aquarium without injury or at least without serious damage; second, if we manage to get them to the door, can we give them an environment that is near enough their normal habitat to make possible a normal life?

Posing these two questions opposite various groups of fishes, the difficulties become more apparent. The deep-sea fishes, living under considerable pressure—such as Dr. Beebe has been writing about so fully in the BULLETIN—give both of our questions negative answers. Fishes

from great depths are usually brought to the surface in a dead or dying condition. Subjection to the abnormally low surface pressures is too much for their frail bodies, and even if an occasional one reaches the surface with some vigor remaining, it is already foredoomed.

Supposing, however, that some ingenious ichthyologist-engineer devised a complicated contraption that could capture such fishes at their normal depths and enclose them in a sealed pressure-resistant vessel, we might be able to get them to the surface. Such a machine has been dreamed of by many, but we still await a working model. Aside from the fact that such a device would be practically a bomb, with its dangerous charge of pent-up pressure, there would have to be powerful pressure pumps to renew the fluid, inject food and remove wastes, all of which tinges the idea with impracticability.

But if a practical pressure trap were available and we succeeded in bringing home a collection of deep-sea fishes, we would still be confronted by the second question, "How are we going to exhibit the creatures and keep them alive?"

It is easy to reply, "In a pressure aquarium, of course." A pressure aquarium, or some sort of tank capable of reproducing conditions in the bottom of the sea, is a thing that lends itself to dreams more readily than daylight inspection. If the device capable of bringing deep-sea fish to the surface unharmed were a potential bomb, what about a tank many times its size? It would have to have steel sides of great thickness, great pumps, super-packing around all connections. Tiny ports of glass might be set in the sides for the use of the curious public—but such glass! Even in the display tanks now in the Aquarium, the glass has to be an inch thick to bear the pressure of water only five feet deep. What would it have to be if the pressure were equal to that of a thousand, or two thousand feet?

Illumination is another consideration. Night reigns perpetually in the vast depths and the creatures of those depths are accustomed to blackness. They have never known light, or had to adjust themselves to it. The strong illumination that would be necessary in our hypothetical pressure aquarium might well destroy them.

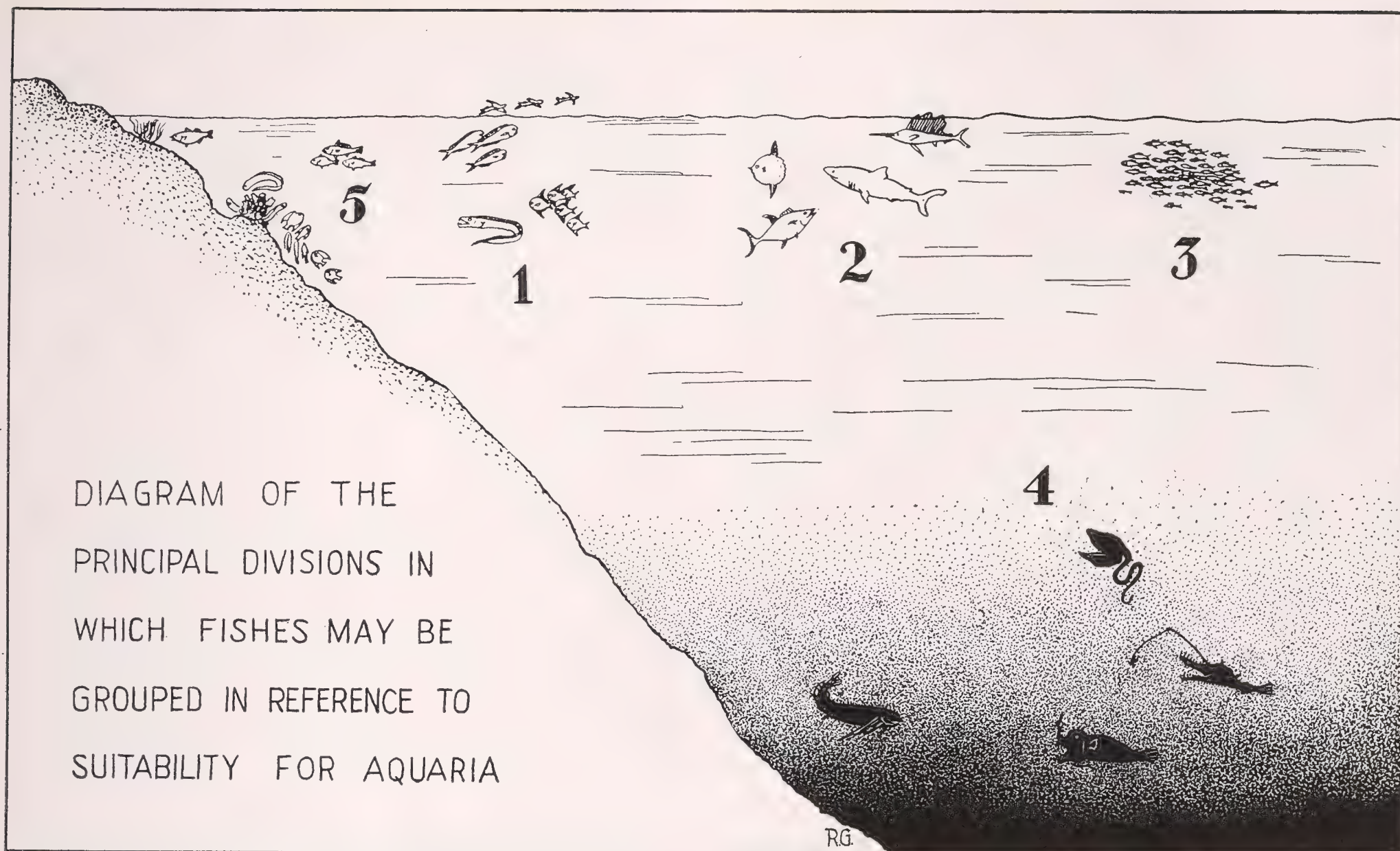
Even fishes caught in relatively shallow depths meet with difficulty when brought rapidly to

the surface. Nearly all of the groupers, fishes always to be seen at the Aquarium, have been treated at the time of capture for the effects of suddenly reduced pressure. The fishermen at Key West, Florida, have a novel and satisfactory way of treating these fishes. When fishing in depths in excess of about thirty fathoms, a peculiar phenomenon occurs after a fish has taken the hook.

As they take in their line, hand over hand, against the dead weight of a grouper, the line suddenly becomes slack and the uninitiated might suppose that the fish had freed itself, or that the line had parted. However, in a few minutes the fish with the line in its mouth bobs up to the surface in an inverted position, with its abdomen greatly distended. The effect is not dissimilar to an extreme case of the "bends," that peculiar disorder to which men working under compressed air are subject when they emerge too rapidly. The higher concentration of gas in the tissue under higher pressure escapes as fine bubbles into the blood stream in both cases. Fishes do not seem to be quite as susceptible to these effects, as will be seen from the treatment methods of the fishermen.

As these men do not have access to ice, they must keep their fish alive until ready for market. Their fishes floating upside down, partly out of water, in their bloated condition would soon succumb for secondary reasons. To prevent this the fisher folk provide themselves with a four- or five-inch piece of umbrella rib, which has a U-shaped cross section. One end of the rib is filed to a sharp point and this simple instrument is plunged through the body wall of the bloated grouper and quickly withdrawn, leaving a U-shaped cut leading into the abdominal cavity. The internal gas pressure in leaving this opening lifts the semicircular flap thus formed. When the pressure is reduced the flap, like a simple pump valve, drops back into place. The fish is able to right itself and the wound quickly heals. This process is known among the fishermen as "winding" their fishes. At greater depths such methods no longer suffice and at present, at least, this primitive method limits the depth at which systematic aquarium exhibits are obtained to what may be considered the surface layers of the sea.

Those forms that live at or near the surface, to which pressure problems do not apply, are so numerous, however, that aquariums are able to



Groups 1 to 4 represent fish that under present aquarium practice cannot be accommodated satisfactorily. (1). Fish of extreme sensitivity to handling. (2). Fish whose great size prevents handling by ordinarily available gear. (3). Fish of such marked social habits as to present a psychological problem. (4). Fish from great depths. Group 5 represents the fish, mostly shore forms, that make up the bulk of aquarium collections. The fishes represented above are purely diagrammatic and no effort was made to draw them in any sort of scale.

show extensive displays of them. But other difficulties apply to many of this group. Of course, the species without special transportation or handling problems are so numerous that no aquarium has ever exhibited more than a small fraction of them.

Many surface fishes have peculiarities that make their handling difficult or impossible. Fishes of the open sea, that normally never approach coasts at all, display a peculiar bit of behavior that is somewhat difficult for human beings to comprehend. Living in a uniform medium, with no obstacles to avoid, many seem to be totally lacking in the ability to evade barriers such as aquarium walls or similar blocks to their path. Either they cannot or will not turn aside, but go on to crash their heads into some obstruction. Obviously there are but two alternatives: eventual death from contusions, or the learning of a new habit. The latter seems never to occur. Among these creatures of such habit are the mackerel, Spanish mackerel, ham-

merhead and several other species of sharks, and the sea herring. The great leather-backed turtle behaves the same way. This may seem difficult to understand, since these turtles periodically do reach sandy shores for purposes of egg laying. However, at these times they approach a shelving, sandy shore and become gently grounded. And that is quite different from crashing into a solid wall of concrete or glass.

The fishes mentioned above are mechanically unable to back up and always reverse their direction by making a U-turn. This to some extent is apparently associated with an oceanic habitat. As a matter of fact, the bulk of shore fishes that are adept at dodging in and out among rocks are quite able to—and regularly do—back up, but there are numerous exceptions, such as many shore sharks, which can make such abrupt turns that they are able to avoid most obstacles without touching them. The greater number of species to be found in aquaria belong to the great variety of shore fishes, including some

that avoid obstacles by turning suddenly, but chiefly those with backing ability.

Both herring and mackerel, although listed as fishes lacking a sense of obstacles, have nevertheless been kept in aquaria. This was done by taking advantage of a feature in the psychological pattern of these fish. In the case of the herrings, it was accomplished in the London Aquarium and of the latter in our institution.

In order to understand the trick played on the fishes to protect them against themselves, we must digress into a brief consideration of other habits which they both display. In common with many open water species, these show a very strong schooling instinct and represent the acme of gregariousness. Normally they are never found as isolated individuals, but in evenly spaced ranks. Moreover, while they will not avoid solid objects, a disturbance or motion in the water will cause them to swerve. They keep swimming ahead throughout life and seemingly, the swimming motions are as automatic as respiration or heartbeat in other animals.

Now, if in a state of nature such a school is deflected two or more times in rapid succession and to the same side, the vanguard of the school sights the laggards and speeds to join them, thus causing the whole school to travel in a circular path—what fishermen call “milling.” This occurs most frequently when predacious forms are attacking them.

After the milling school is once established, it requires a truly violent disturbance to disrupt it. If a sufficiently large group is placed in a capacious tank, circular or elliptical, the fishes will almost immediately form a circular school. At first they butt into the wall, but as they are deflected to one side and from then on repeatedly to the same side because of the curving walls, eventually the leaders follow the trailers and the “mill” is started. When it is once formed the fishes no longer strike the sides and are free from further injury.

The British erected a central core of stone in their tanks to prevent their herring from sighting across the diameter of the circle and becoming confused. We did not find this necessary, however, for our mackerel. Since these schools are kept intact by purely visual means, it was necessary to keep a light burning at all times

so that the school would not disintegrate with consequent injury to its members.¹

As this seems to be a fairly simple operation it may be wondered why such schools are not normal features of aquaria. The difficulty lies in the collecting—our first problem. A large number must be obtained in order to form such a circular school and the fishes show an exceedingly delicate reaction to the mechanics of net handling. In brief, no regular source of supply, insuring safe delivery to the Aquarium, is available.

The question of net and other injury brings up another limiting factor. Various fishes that are fairly available simply fail to survive ordinary handling methods, while others, because of peculiar physical features, tax to the utmost the skill of those charged with their transportation but when once established in an aquarium survive satisfactorily.

During the summer months a certain long, slim gar fish, *Strongylura marina*, with a long beak, may be taken in lower New York Harbor by customary seining methods. While superficially specimens appear to be sound, death usually follows before, or at latest shortly after, arrival at the Aquarium. In 1930 a scheme was devised of simply surrounding the fishes with a net and then herding them into a vessel from which in turn they were released into the aquarium provided for them. Since this procedure was established these fishes have always been a regular feature of our display.

Even more delicate are the small river herring landlocked in Kensico Reservoir, but they, too, survive such careful treatment. These little herrings are so sensitive to mechanical shock that death ordinarily follows the simple act of lifting them gently from the water in a soft dip net and immediately returning them. Usually there is a shower of silvery scales, a few moments of dizzying circling and then the quietude of death. There is some good evidence that this condition, which runs more or less through whole groups, is rooted in certain peculiarities of their physiological makeup. These groups frequently have strong schooling

¹ A study of the influences at work on this school of mackerel was made by Professor A. E. Parr and published in *Occ. Pap. Bingham Oceanographic Coll.* (1): 1-32. “A contribution to the theoretical analysis of the schooling behavior of fishes.”

habits, are extremely reactive and have other features in common. A study of just what elements are involved is underway, but it would be premature to discuss the details. It may be said, however, that many of the herrings and herring-like fishes—the silversides, the gars, flying fishes and half beaks, to mention only a few—possess this unfortunate delicacy, with the result that few representatives are on view in aquaria. The eggs of these fishes do not share the extreme delicacy of their producers and when obtainable may be the basis of such collections as are occasionally found.

The hammerhead shark, already eliminated for other reasons, would undoubtedly fall into the class of fishes not suitable for aquaria because of the ease with which the sensitive eye expansions are injured by blows. In the confines of an ordinary aquarium injuries could hardly be avoided.

Another excluding item involves not so much specific differences as absolute size. The handling of an ocean sunfish of, say, half a ton, or a shark of only half that size, is not a simple matter, and these weights measure only specimens of modest dimensions. Attempts at impounding them are almost invariably fatal to the fish, and the handling of them may be hazardous to the fishermen, as well. Even after such a creature is taken in a large fish trap or hooked on a strong line, the immediate question of transportation is baffling. If a secure tackle is placed about the fish (itself no small task if the fish is vigorous—and others are useless) it may be hoisted on deck, supposing a sufficiently large tank or “well” to be available. But in the short transit from ocean to tank fatal damage is done. Because these animals are normally supported in water, the visceral muscles and supporting structures are not capable of retaining the great mass of organs against their weight in air. This becomes strikingly evident when supported at various points by the hoisting tackle. As a consequence there follows extensive derangements of the digestive and other apparatus, generally accompanied by rupture and hemorrhage which shortly spell the end. The writer has seen rays of less than two hundred pounds killed in this manner. Smaller animals of the same species may be handled with impunity, largely because the weight increases as a function of the cube of such a linear

measurement as the length; that is, the weight increases at a much more rapid pace than the length, in accordance with a physical law.

If such a fish could be towed to the Aquarium door—a generally unsatisfactory procedure, for other reasons similar to those of wearing out a fish or an angler’s line—it would still have to be lifted out and transferred to a tank. If a method could be devised similar to that used for extremely delicate fishes, these huge creatures might conceivably be transported. However, the equipment in tanks with their consequent tons of weight, the hoisting apparatus necessary and the concomitant expense, places such efforts well beyond the possibilities of the usually closely limited budgets of public aquaria.

The consideration of environmental demands and biological peculiarities of many fishes that aquaria are not successful in harboring serve to point out just a few of the many things that wait on the ingenuity of biologists and aquarists to work out. The points mentioned in this article may be tabulated as below, considering those which may be controlled and are more or less satisfactory, and those which await an adequate solution. The latter are printed in italics.

Environmental elements:

Temperature.

Radiation energy (sunlight, etc.).

Pressure (only relatively slight pressure controllable).

Flow of water (strength, turbulence, etc.).

Chemical nature of water (acid, hard, sea, etc.).

Volume (shape of tank, fittings, etc.).

Biological elements:

Food (generally fairly satisfactory).

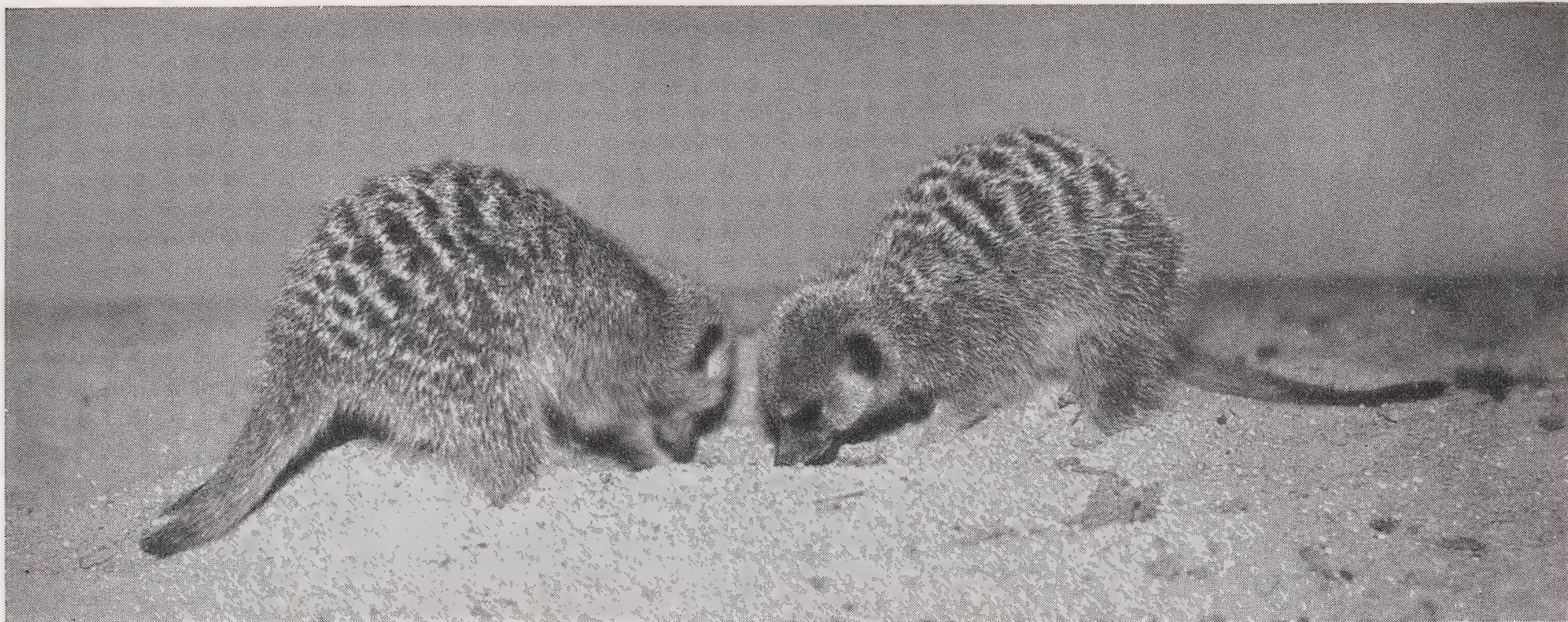
Disease (partly controllable).

Physiological delicacy (a purely biological question?).

Psychological peculiarities (a purely biological question?).

Huge size of specimens (a purely mechanical question?).

Although there are lifetimes of study in the details of those items *not* in italics, the success of modern aquaria is a measure of the progress made along these lines. The solution of the four in italics, however, would open up entirely new vistas in the management of aquaria.



Two new meerkats from South Africa enjoy digging in the sand.

“What’s New Today?”

It’s a Question that Interests the Public and the Zoological Park Staff
Alike When a Big Shipment of Animals Arrives

CLAUDE W. LEISTER

“WHAT’S new today?” or its equivalent is probably the commonest of the thousand and one questions asked keepers and members of the Zoological Park staff.

For not only must the collections in a zoological park include a large number of specimens in order to be fairly representative of the world’s animals, but occasionally an animal must have the magic word “new” applied to it in order to satisfy the visitors. Some of the mystery and glamor of the wild clings to a newly arrived animal and the public recognizes that fact and bestows its attention accordingly, sometimes even if essentially finer examples of the same species have been on exhibition for a long time.

Nor is the public reaction entirely misguided. A newcomer often actually has more exhibition value than one that has become accustomed to crowds of visitors. The new animal may be uneasy, attentive and watchful whereas the old-timer next door is, in all probability, sleeping right through the biggest crowd of the year.

New arrivals are likewise of great interest to members of the staff. Almost every shipment contains something of note. Even in a group of the commonest animals there can usually be

found some interesting variation in color, size or temperament. In the case of rare or uncommon species the interest lies in making close observation of all strange reactions and mannerisms, since in many instances very little is known concerning the habits of the animal.

Every year the Zoological Park receives requests from persons who wish to be made members of the next Zoological Society expedition bound for foreign lands to bring back animals for exhibition. Of course our replies to such requests always point out that practically no animals are obtained in that way. The cost of such an expedition would be far in excess of the actual value of the animals that could be captured in the time available. Instead, animals are purchased from established animal dealers, whose connections in remote corners of the world enable them to procure desirable specimens at prices the Zoological Park can afford to pay.

Let us see what a consignment of wild animals has in store for us:

This year shipments did not arrive with any degree of regularity and animals from different and far distant parts of the world were received at the same time. Ordinarily, a shipment repre-



The new giant anteater from South America presents a weird picture as it stalks about its runway searching for a colony of ants to lick up with its long protusible tongue.

Two Bactrian camels came to the Park in July, along with a dromedary camel, and here the first of the Bactrians is being introduced to the Camel House and its corral. Below is one of the golden cats from the Indian region—"in temperament just as mean and cantankerous as a cat can be."





The little panda with its white face and upright ears is one of the handsomest of the new arrivals, and doubly interesting because the Park had not exhibited any for several years. Below is the tapir that arrived in a recent large shipment of South American animals.



A playful baby ocelot that looks and frequently acts like a kitten is another newcomer from South America.



sents the animals of a particular region, Africa, for instance, or India and Malaysia. During the latter part of June our largest single purchase included animals from South and East Africa, India and Malaysia, and South America.

What an aggregation of animals! An aardvark, from South Africa, sometimes not offered on the market for years. Then a fine pair of golden cats from the Indian region, handsome creatures about the size of an ocelot. The body color is a rich tawny chestnut while the lighter head is striped with dark brown. In temperament they are just as mean and cantankerous as a cat can be. Next, a pair of dusky langur monkeys, also from Asia, and a species which we never exhibited before.

A large crate reveals a sturdy young kudu. His horns, just a few inches in length, give no indication of the handsome structures to be produced within a few short years. The kudu is regarded by many persons as the finest of the African antelopes and good specimens are rarely seen in captivity. This youngster should make a suitable mate for our female kudu born in the Park about two years ago. Another African crate holds a blesbok, this time a female, and intended as a mate for our male blesbok on exhibition during the last two years.

A number of boxes labelled "Para—Brazil," contain several species of ibises, among them



The young kudu takes the greatest interest in everything that goes on and his eyes never left the photographer.

the showy scarlet ibis. Four of these make a welcome addition to the Great Flying Cage. An Andean goose peers out between the slats of another crate and soon goes to join our remaining specimen of this species in the Goose Paddock. Another crate from South America contains a tapir. Still another a giant anteater, one of the strangest of the world's mammals.

Getting back to the last of the crates and boxes on the truck we make, in many respects, the most interesting of all our finds—the little panda from southeastern Himalaya. There are two of these little animals, the size of a large cat, with white faces and upright ears. The body is generally a rusty red color and similarly colored rings encircle the tail. It is this ringed tail which gives the panda a fancied resemblance to our raccoon.

It has been some years since we exhibited these animals, so interesting to zoologists because they have at various times been classified with the bears, the raccoons and finally placed in a group by themselves. They should not be confused with the giant panda which comes from the same region but has never been kept in captivity.

The little panda is a vegetarian. In a wild state its food consists mainly of the succulent new shoots of bamboos and other plants. In



And here is a new arrival—but not from a far land. The young tahr is one of several born in the Park this year.

captivity it is fed cream of wheat—and the inevitable codliver oil.

The reptiles, all from South America, have been left to the last and the boxes are taken to the Reptile House where they can be opened for examination. First come some rat snakes—short tempered but non-poisonous. Then specimens of one of the most beautiful snakes in the world, the green tree boa. The body is a beautiful shade of light green with coarse markings which appear to be applied with Chinese white. The under side is a pale yellow. The young of these boas possess the same markings as the adults but, curiously enough, the ground color, instead of being green, is a bright red-brown. Two young boas were born en route to the Park and one survived and was put on exhibition. Other boxes contain a crocodile and two species of iguanas.

Reptiles, snakes especially, usually require nothing but water on the journey from their native land to the Zoological Park. Since many species are poisonous and potentially extremely dangerous, snakes are seldom re-crated by the dealer and as a rule arrive in the same boxes in which they started their long trip. Frequently

these boxes are handmade, of carefully joined and fitted materials, examples of a manual skill seldom encountered in our machine age. The wood used is usually native to the region and thus it is not at all uncommon to see mahogany boxes from South America and teak from India.

Sometimes, from Africa, more infrequently since the influence of the white man has spread so universally to the interior, reptiles are received in peculiarly shaped receptacles entirely of native manufacture. They are crudely but strongly made of splints, vegetable fibres and rawhide thongs. Designed for transportation by native carriers, they were taken to some river town or seaport, to be purchased, along with their contents, by some itinerant dealer in wild animals who was awaiting the sailing of his ship. Thence to America.

These few comments will indicate that an endless variety of interesting things may occur in connection with the receipt of a shipment of wild animals. Fortunately, enough has been said, perhaps, about this particular shipment, for as this is being written, word has just come of the arrival of a pair of Bactrian camels—and the urge to leave writing and go see them unloaded is too strong to resist!



Ellis Joseph exhibits some of the reptile cages of native make.

A Sea Pigeon at the Aquarium

Like the Octopus, It Is a Difficult Creature to Maintain on Exhibition,
but Its Interest Justifies the Effort

C. W. COATES

ANY inhabitant of the sea which is of a size suitable for exhibition and which will not tax our facilities beyond the breaking point finds a ready home in the Aquarium, and our candle is out for any number of fishes and other aquatic animals that do not seem to appreciate the care we are willing to lavish upon them. This criticism may be levelled at invertebrates particularly for these, as a group, respond indifferently to our efforts.

The difficulty of maintaining ocean water, as such, in a closed circulating system is undoubtedly the cause of our limited showing of such creatures. Consequently, when any of these extremely interesting animals arrive and remain alive for more than a few days we feel a pleasant sense of accomplishment.

Early this year Mr. J. F. W. Emde, an ardent amateur collector for the Aquarium, brought us several sea pigeons from Bermuda. They are quite common in those waters, but we have never had any before. They are not very good travelers and seem to have little idea of keeping out of trouble. This particular collection caused a good deal of flooding on the ship on which they were carried, the SS. *Volendam* of the Holland America Line, by getting themselves into the drains and overflows of the bath in which they were accommodated. Those caught in such places died, but three arrived at the Aquarium—all of different species, as far as we could make out. One of these was in bad shape and died almost immediately, but the other two lived well for a few weeks, when the largest of them died. The third is still on exhibition and is apparently doing very well. We are unable to identify this specimen in life, for there are about one thousand known species almost identical except for internal characters. The two dead ones decomposed so rapidly that identification was impossible.

However, in spite of the lack of a formal

name, the creature is an excellent exhibit. It is a dark reddish-brown, about ten inches long, with a slug-shaped body—it is a slug or shell-less snail—and is equipped with a handsome pair of wing-like appendages with which it gracefully propels itself about the tank. It looks for all the world like a bird lazily flying through the water.

When it is annoyed, it will release a quantity of dark ink-like fluid, providing a screen behind which it makes good its escape. This fluid may be collected and used in a fountain pen. It will make a permanent record on paper.

Our present specimen has been depositing long strings of bright yellow eggs about the tank for about four weeks, but none of these seems to be fertile. Each string is several yards long, composed of a mucous-like substance which quickly hardens into a stiff jelly. The strings are about the thickness of coarse thread and each contains an estimated half million eggs. Several of these strings are deposited daily and become tangled and twisted about each other until they look like a loosely rolled ball of fine twine.

The creature is living very well on sea-lettuce, of which it eats a good teacupful every day.

The exhibition of another invertebrate, the common American octopus, *Octopus americanus*, for several weeks this spring was a source of much gratification to our visitors, although we are afraid that many people who saw an octopus for the first time were disappointed that it was not larger. It seems to be pretty definitely established in people's minds that the octopus is an enormous creature that would make short work of a man, instead of a small, comparatively harmless animal. We exhibited two of the creatures during the spring.

Our latest octopods were each about two and a half feet across the tentacles and were exhibited in a special tank designed by Mr. Ham-

ilton Knowles of the New York Aquarium. This was particularly good for exhibiting them, for it had four glass walls open to the public, but this exhibition of them was also their undoing, in all probability, for octopods are shy, retiring animals and being looked at all day was probably much too much for them. They lived for five weeks before they succumbed. Our record for the exhibition of these creatures was fifty-

two days, established last year but eventually we may be able to keep them much longer.

Like other invertebrates, the octopus does not live well in stored seawater, although there are records of several years' exhibition from aquaria which can pump good ocean water directly from the sea to their tanks. It is impossible for us to provide this kind of water because of the pollution in New York Harbor.



This all but formless creature is a sea pigeon, the first one ever exhibited at the Aquarium. Its wing-like appendages propel it lazily around its tank and it really resembles a bird flying slowly and gracefully through the water.

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NOTES FROM THE ZOOLOGICAL PARK AND THE AQUARIUM

"Man-eater"

The great white shark or "man-eater," *Carcharodon carcharias* (Linnaeus), cosmopolitan in warm seas and straggling to more temperate climes under the influence of favorable currents, appears rather infrequently in New York waters. In 1916 there was a genuine shark scare and undoubtedly authentic records show some actual injury to swimmers. Nevertheless, there are certainly more of these creatures in local waters than most people seem to realize. Fortunately they are apt to be off shore, but because of the increasing interest in tuna and sword fishing more attention has been called to them. In fact, anglers now make some sport of shark fishing when the more desirable species are not biting; so much so that shark records have crept into lists of anglers' record catches.

Quoting from the *World's Record Fish*¹ we find that the record anglers' "man-eater" was taken off Brielle, New Jersey, June 8, 1935, by Mr. Francis Low. It measured 12 feet in length and weighed 998 pounds.

On June 7 of this year Mr. Bache McE. Whitlock took a shark on a hook and line and it proved to be little smaller than the record, being 10 feet 9 inches long. Mr. Whitlock caught the shark while cruising on the *Cyemba* about twelve miles south of the Nassau Hotel and sent the head to the Aquarium for identification. No scales were available at the time of capture, so the weight is not known.

The largest definite record of capture by any method is that of a shark 13 feet and 3 inches long, weighing 2,176 pounds, reported by Mr. W. R. Selkirk, Cape Province, South Africa, in June, 1928. That report is

¹ Compiled by Van Campen Heilner and Ray Schrenkeisen of *Field and Stream* and Francesca R. La Monte of The American Museum of Natural History.

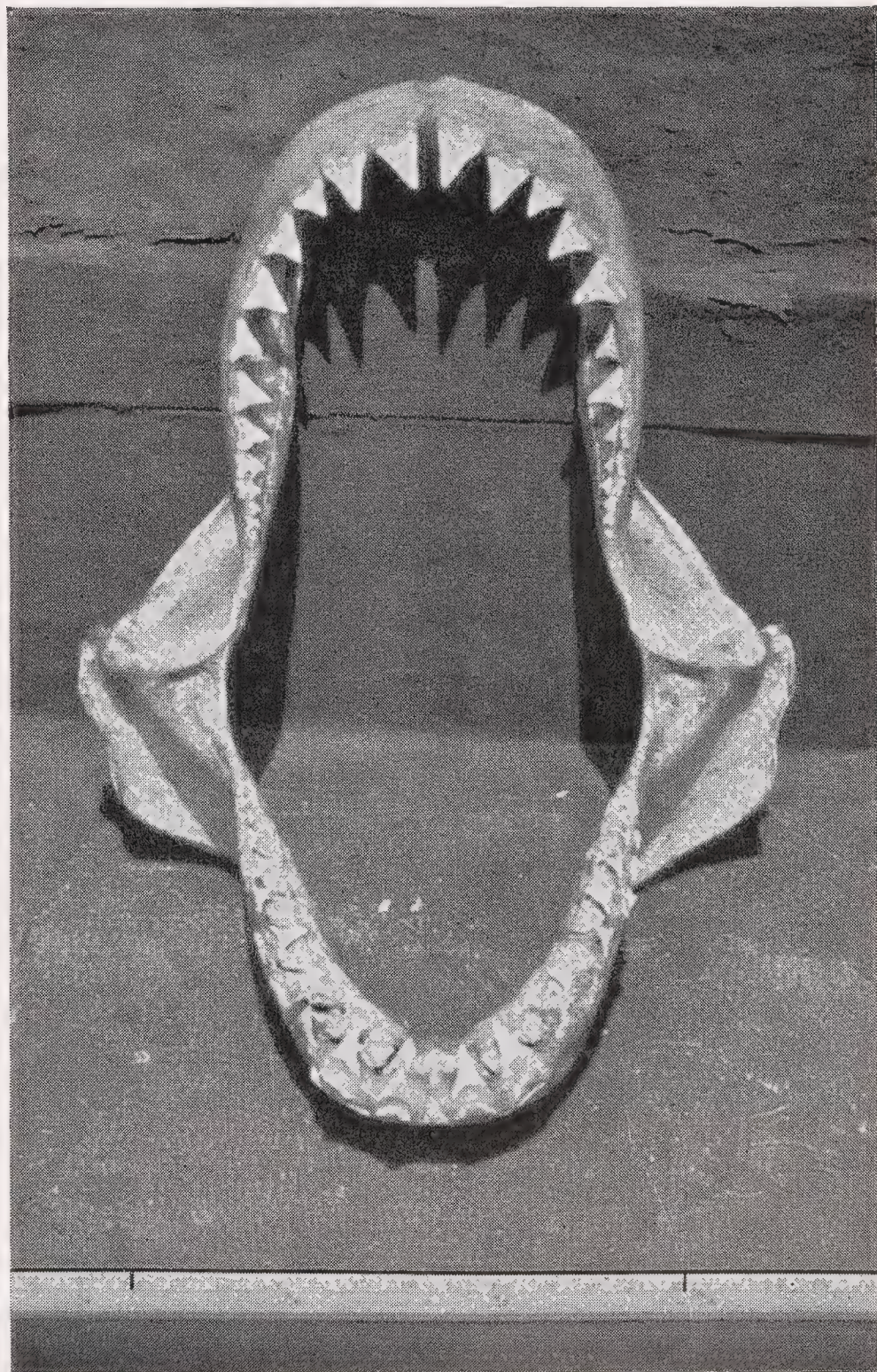
recognized as valid by *World's Record Fish*. Other book statements which are more or less unauthenticated reach all the way to 30 feet in length.

Generally these fishes keep well off shore, beyond the normal range of swimmers, and it seems that only on rare occasions does an individual venture close enough to the coast line to represent a menace to man.—C.M.B. Jr.

Romance

Strange romantic attachments between birds often wholly unrelated are common enough in the Zoological Park, where propinquity often surmounts obstacles otherwise unscalable. A goose may fall in love with a gull, an ibis with a pelican. But where mates of the same species are available, the normal urge of nature remains as strong as ever. When it happens that representatives of local breeding species are housed in outdoor aviaries, wild birds are sometimes drawn to them. This is especially true of the Baltimore oriole and the rose-breasted grosbeak, which often find the Dome Cage irresistible during spring migrations. But within the memory of our oldest inhabitant, this attraction has only once affected a crow.

The crow is notoriously a wily bird and the fish



These are the jaws of the man-eater shark caught in local waters, narrowed considerably by drying. The marks on the ruler represent a distance of 1 ft.

crow, our local inhabitant, is no less canny than his larger relative. Perhaps this intelligence has enabled the fish crow to survive in spite of the encroachments of the city. At any rate, he continues to exist here in some numbers and has added an unexpected cheekiness to his other accomplishments. For the past two or three years a female of this species, taken from the nest and reared by hand, has been kept in a large cage at the northwest corner of the Bird House. Each spring her husky fish crow voice has been heard in loud summons, but if there was a reply, it was inaudible to us.

This year, however, there was a definite and surprising response. A wild crow, presumably a male, heard the appeal, came down to investigate and was so overcome that he forgot his native caution and refused to leave. The sudden devotion of the pair was so obvious that we made hasty plans for a union, but before they could be put into effect, further complications arose. A second wild crow, this time presumably a female, arrived on the scene. It might easily be conjectured that this was the true spouse of an errant husband, come to bring him to book. At any rate, after two days of noisy wrangling, the pair left together and were seen no more. Our own bird, happily, has not died of a broken heart and perhaps next spring she may have better luck.—L.S.C.

Forbidden Animals

Recent regulations of the Department of Agriculture have added several species of birds and mammals to the list of animals that may not be imported into the United States because they are declared to be "injurious to the interests of agriculture and horticulture." The ban against their importation permits no exceptions for zoological parks and other scientific institutions, as importers have found on several occasions recently when they attempted to bring in specimens of the Malay fruit bat, the so-called "flying fox," for distribution to zoological parks.

The complete list of forbidden birds and mammals follows:

BIRDS:

Skylark	<i>Alauda arvensis</i>
Common or House Myna.....	<i>Acridotheres tristis</i>
Crested or Chinese Myna, or	
Starling	<i>Aethiopsar cristatellus</i>
European Bullfinch	<i>Pyrrhula pyrrhula</i>
European Yellowhammer	<i>Emberiza citrinella</i>
Greenfinch	<i>Chloris chloris</i>
Chaffinch	<i>Fringilla coelebs</i>
Starling	<i>Sturnis vulgaris</i>
English Sparrow	<i>Passer domesticus</i>

MAMMALS:

Black or House Rat.....	<i>Rattus rattus</i>
Roof, Alexandrian or White-	
bellied Rat	<i>Rattus alexandrinus</i>
Common or Brown Rat.....	<i>Rattus norvegicus</i>
Common or House Mouse.....	<i>Mus musculus</i>
European Rabbit	<i>Lepus cuniculus</i>
European Hare	<i>Lepus europaeus</i>

All species of mongoose or mammals of the family Mungotidae, sometimes known as ichneumons or Pharaoh's rats, and all species of fruit bats or "flying foxes," or mammals of the family Pteropodidae are also forbidden entry.

Three White Crows

In May, 1935, a letter was received at the Zoological Park, stating that the writer, Melvin Fleming, of Woodstock, Illinois, had in his possession three albino crows. Mr. Fleming had seen a statement that the only white crows ever included in our collections were two specimens with black pigmentation about their heads, and thought we might be interested in his birds.

Arrangements were made for the purchase of one of the crows which arrived here on June 8, 1935. This bird was quite white in plumage, beak and feet, and the eyes were pink. We were so impressed with the striking appearance of this specimen that we hastened to acquire the two others, which were safely received on June 16. Except for the slightly smaller size of one bird, the three were indistinguishable, all being entirely free from pigmentation.

The occurrence of three rarities of such importance in one locality and at one time, naturally gave rise to much speculation as to their origin. In reply to our letter of inquiry, Mr. Fleming wrote, under date of June 25: "I found three white crows, and one black crow in the same nest, about two months ago. They were quite small when I found them. I have never seen any white crows in our locality before, or anybody else. But I have seen a crow with a white feather in her wing. I didn't see the mother of these birds but I expect she is, for I saw her in the same timber that I found the young crows . . . the black one died . . . After I had the crows for a while I noticed that the white crows became very tame. But the black crow always acted wild . . . never got tame."

The appearance of three albinos in a nest of four young seems to make this record one of unusual interest. Mr. Fleming's letter indicates at least a probability that no white parents were involved, although, of course, the possibility still remains. On the other hand, such a ratio of albino offspring from heterozygous parents presents a genetic problem that seems to warrant placing the occurrence on record.—L.S.C.

A Vampyrus spectrum Is Born

One of the most important events among the mammal collections in a number of years is the birth of a giant South American bat of a species scientifically known as *Vampyrus spectrum*. It is the largest bat of the New World tropics, having a wingspread of a yard, and our specimens are the first ever to be exhibited alive in a zoological institution.

The species was named by Linnaeus in 1766 and was then thought to be the bat that attacked humans and cattle and drank their blood. The early explorers brought back tales of this great bat fanning its victims into deep slumber with its wings. The actual vampire, a truly sanguineous bat, had not as yet been identified and provided with a scientific name. In later years the giant bat was declared to be a harmless, fruit-eating animal. It appeared to be rare and few preserved specimens found their way into the museums.

In 1934 the writer was in Trinidad and heard that these bats lived in single pairs in the hollows of large silk-cotton, or ceiba, trees. Also, that they were savage and entirely carnivorous. In the summer of 1935 he again went to Trinidad and concentrated on a search for *Vampyrus spectrum*. Two pairs were captured and placed on exhibition in October of last year.

The young *Vampyrus* was born on July 14. It appears to have a wingspread of about 14 inches. It is



Keeper Cully had no difficulty in getting the anoa to pose for a picture showing how it opens the door. He simply turned the animal into its stall, closed the door, and stepped back out of sight. That was all the urging the ingenious creature needed.

quite devoid of hair and clings to the mother in an inverted position except when nursing. The father is quite solicitous about the infant, spending much time in grooming it. Its rate of development will be noted with interest, as little has been known about the habits of the species. We have, however, demonstrated that *Vampyrus* is entirely carnivorous.—R. L. D.

New Floor in the Reptile House

After being closed for three months during the spring for the laying of a terrazzo floor, the Reptile House was reopened on July 2. The bellowing of the alligators vied with the clatter of the pneumatic drills tearing up the old concrete floor during the first day or two, but later the inmates became accustomed to the noise. Despite the shifting of cages necessary to clear the floor and the confinement of the poisonous serpents in small cages behind the large glass fronts for a while, as a precautionary measure while the drills were shaking the glass, the collection came through with scarcely a loss, and none of importance.

The Anoa Learns a Trick

Keeper William Cully of the Kangaroo and Wild Swine House had a small mystery on his hands during the winter. On a cold morning when all his charges were locked in their warm stalls, one of the

anoas was found to be outside—with the door bolted behind him.

The fact that the animal was trotting around in the snow did not concern the Keeper, since he turned the anoas and a few other animals outside for an hour or two every day, anyway. But he knew he hadn't turned this particular animal out.

After he drove the pigmy buffalo back into the stall and stood aside to watch, he soon discovered the secret. The door to the outside corral is operated by a draw-rope which lifts a bar, and the free end of the rope is generally tied to a bar on the front of the cage where the keeper can reach it. By standing in his water trough, the anoa could grasp the rope in his teeth and lift the bar, pulling the door open an inch or so until the bar fell outside the latch. Then, with his horns, the animal pried the door open and slid through while the door banged shut behind him. By tying the draw-rope at the top of the cage Keeper Cully managed to regain control of the anoa's comings and goings.

The babirusa in an adjacent cage also developed a technique of escaping into the outside corral. Its method was to rear against the door and push the bar open with its snout.

School Menagerie

"The girls fairly loved these animals, especially the monkey whom they taught to drink milk from a

glass, the kinkajou, the coati and the skunk. Each one in its individual way was charming and came in for its share of petting," a teacher of Washington Irving High School in charge of Nature Extension wrote Dr. Blair at the end of June in returning to the Zoological Park a small collection of animals lent at the beginning of the school year. It has been the Park's practice for some time to lend collections of common and harmless mammals and reptiles to the nature study groups.

Washington Irving High School's menagerie this year included an alligator, gopher snake, water snake, two woodchucks, two raccoons, a kinkajou, a red coati mundi, a skunk (deodorized, needless to say), an opossum, a sapajou, a macaque, two guinea pigs and a rabbit.

The total number of visitors to the animal room where the collection was exhibited and studied was 6,905 from September, 1935, to June, 1936. Children from the elementary schools visited the menagerie and heard informal talks on the animals, and high school students in the biology and art classes were other visitors.

"Distribution of Certain Whales"

A technical paper on a zoological subject sometimes arouses controversy, but seldom a spontaneous burst of praise such as Dr. C. H. Townsend's paper on "The Distribution of Certain Whales as Shown by Logbook Records of American Whale-ships," published in *ZOOLOGICA*, Vol. XIX, No. 1, on April 3, 1935, has incited.

In tabular form Dr. Townsend set forth the whale catches of 744 vessels on 1,665 voyages, 53,877 whales having been taken. Four great charts indicated the exact part of the seas in which the whales were captured.

Letters that poured in on Dr. Townsend after the paper was published generously praised it as a thorough and important piece of research.

A Gift of the Junior Auxiliary

Early in the spring the Junior Auxiliary of the Zoological Society voted, in response to a questionnaire, to present a giraffe to the Zoological Park as the next of a long series of interesting and important gifts.

The giraffe arrived early on the morning of July 14—a magnificent young Masai giraffe, approximately 10 feet 8 inches tall.

Its captor and careful guardian on the long journey from Africa was Christoph Schulz, whose business card bears the inscription: "The Only Wild Animal Game Ranch in Africa. Giraffes, Rhinos, Elephants, Zebras, Antelopes and Small Game, Birds, Direct from the Veldt to the Zoo." Mr. Schulz delivered the giraffe himself and saw it safely removed from its tall crate and liberated in the Antelope House in a cage adjoining that of the Park's other giraffe.

Over a long-delayed breakfast Mr. Schulz told the story of the young giraffe.

"We tried to capture this very animal last year," he said. "We came upon her in very bad country overgrown with mimosa, acacia and 'wait-a-bit' thorn. It was country that a horse cannot penetrate and the young giraffe ran away in a wild seisel field.

"When we went back this year, I saw the same animal with her whole family—six other giraffes. I knew it was the same one, because she was very dark colored. So I said to myself: 'There is a very fine

animal, just the size the New York Zoological Society wants.'

"This time we caught her, very gently, with a lasso without harming the others, and in three hours she was on my ranch at Arusha in Tanganyika.

"Oh, at first she didn't like being there. She was 'insulted' and she cried. For four days she would not eat, and then she got over being 'insulted' and ate beautifully.

"It is perhaps thirty miles from the veldt where we caught her to my ranch, and twenty-seven miles from my ranch to the railroad station, which is three hundred miles from the coast. Presently when we were ready to leave Africa with a large shipment of animals, we took her to the coast and put her aboard the *City of Lyon* with the other animals. Coming around the Cape of Good Hope it was very cold and stormy and the ship rolled. There were other giraffes aboard, and each time the ship rolled their long necks would bend over the sides of the crates, from one side to the other. We put sand in the bottom of the crates so they could stand better, and each time the sea would break over the deck and wash it out."

The new giraffe took kindly to her new life in the Zoological Park. A few minutes after she was liberated in her stall she wandered over to the tall wall that divides her from the neighboring male giraffe and the two animals got acquainted by rubbing noses. To accustom her to her stall, so she would not be afraid to reenter it after being turned out in the corral, she was kept inside for a week.

PUBLICATIONS OF INTEREST

BIRDS IN THE WILDERNESS. By George Miksch Sutton. The Macmillan Company, New York, 1936. 200 pages, 12 illustrations, 4 in color. \$3.50.

The twenty-two chapters which make up the contents of this book are devoted to experiences with birds, ranging from childhood encounters to the mature investigations of a full-fledged ornithologist. They are packed full of first-hand observations, related with never-failing zest. Most of North America is covered, in one anecdote or another, but the highlights seem to center in two chapters relating to Doctor Sutton's work in the far north. The author's interest in that bleak country is so deep that it flows into his words with feeling and sincerity.

George Miksch Sutton is a man of many gifts and not the least of these is an ability to write exceedingly well. Most naturalists have had countless experiences similar to those described in this book but few indeed can get them into black and white with such undeniable charm. Little fault is to be found with the style but if there is complaint to be made, it will relate to over-free use of the short sentence, which noticeably checks the flow of thought in some sections. Let us hope that Doctor Sutton will not allow himself to be unduly influenced by editorial fancies in future volumes.

A tribute to Louis Agassiz Fuertes, in Chapter IV, is of particular interest, for it is difficult to avoid the feeling that if Doctor Sutton cared to devote himself more fully to brush and pencil, he might well become the successor to our greatest artist. The reproductions of his work in this book are of unequal merit, perhaps because of the disparity in dates. But the best of them fully demonstrate that here is an able writer, equally at home in the field of art.—L. S. C.

Serpents of the Northeastern States

By RAYMOND L. DITMARS

HERE is a comprehensive, yet compact, book about the snakes of the northeastern states that will prove to be extremely useful to everyone with a summer home or camp in that region. This guide to the venomous and non-venomous reptiles of the New England area, New York, New Jersey and eastern Pennsylvania, is a practical and handy reference work. It gives a key for ready identification of snakes, descriptions of their feeding and breeding habits, notes on distribution and photographs of every species found in the northeastern states, including color plates of the copperhead and rattlesnake. One section is devoted to the emergency treatment of snakebite.

"Serpents of the Northeastern States" was originally published as a complete number of the BULLETIN and several reprintings were quickly exhausted. It has been republished in a new format, somewhat revised as to text and nomenclature, and four photographs have been added.

60 pages, 41 illustrations.

50 cents postpaid.

Department of Publication & Photography
NEW YORK ZOOLOGICAL PARK
185th Street & Southern Boulevard
New York, N. Y.

PUBLICATIONS

Free to Members:

Bulletin: The official publication of the New York Zoological Society reports bi-monthly on interesting phases of work at the Park and the Aquarium and contains articles on natural history in a sound yet popular form, with many illustrations. Thirty-eight volumes have been completed.

Zoologica: Scientific contributions of the New York Zoological Society. Volumes I-XIX are complete, and other volumes are in preparation. *Zoologica* is illustrated and is published quarterly, with an index to each volume bound in Part 4. It is sent to Members on request.

[*Zoopathologica*, Scientific contributions of the New York Zoological Society on the diseases of animals, has been discontinued and future papers on animal pathology will appear in *Zoologica*. *Zoopathologica* is complete in Volumes I and II, which are indexed.]

Annual Report: Documents, reports and pictures of the work of the various departments of the Park and the Aquarium. As a rule it contains articles of scientific value and considerable general interest.

Gallery of Wild Animal Paintings in the Zoological Park: A handsomely illustrated catalogue of the gallery in the Administration Building at the Park, which Members may receive on request.

A classified list of the publications of the Society, with subject headings of articles printed in the *Report*, *Zoologica* and *Zoopathologica*, as well as reprints from them, will be furnished on request. Some of the publications have become exhausted and orders for any issues will be governed by this circumstance. Orders for any of the publications should be addressed to H. R. MITCHELL, *Manager, Zoological Park*, 185th street and Southern Boulevard, New York City.

No effort will be spared to ensure delivery of the regular publications to Members of the Society, but changes of address, forwarding points and non-delivery of mail should be reported promptly. Back numbers of *Bulletin* still in print will be supplied to Members and others at the rate of 30 cents each. Postage and handling, 5 cents extra.

Clark and Fritts, New York, Printers.



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NEW YORK ZOOLOGICAL SOCIETY



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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

Annual Membership in the Society is \$10, renewable annually. Life Membership may be obtained for \$200. A contributor of \$1,000 becomes a Patron; \$2,500 an Associate Founder; \$5,000 a Founder; \$10,000 a Founder in Perpetuity, and \$25,000 a Benefactor.

All classes of Members are entitled to receive every periodical publication, the privileges of the Administration Building with its lounges and reception rooms and gallery of paintings of animals, to attend lectures, open meetings and entertainments, and to be admitted free to the Zoological Park and the Aquarium every day in the year.

Application for Membership may be given to the Director of the Zoological

Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 101 Park Avenue, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



The goal of the expedition—Kaieteur from the air.

BULLETIN

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The Society's Expedition to Kaieteur Fall

En Route to British Guiana, the Department of Tropical Research Gathers
Data on Method of Catching Flyingfishes in Barbados

GLORIA HOLLISTER

Research Associate, Department of Tropical Research

ONE cold snowy morning last winter I had a semi-conscious realization that it was an anniversary or day of importance that should be recognized. Soon the succession of events of the morning put this query in the background, but it returned a few hours later in perfect memorable detail. Exactly ten years before I had sailed for British Guiana on my first trip to the tropics. The ten year interim had flown by rapidly and often I had hoped for an opportunity to go back.

Good fortune attended this wish and in a few short weeks, plans, preparations and necessary outfitting were completed for the Twenty-third Expedition of the Zoological Society's Department of Tropical Research. The many things that could be attended to in Georgetown, the capital of British Guiana, were left until that day when I should arrive. So, on the second of April, I sailed on the R. M. S. *Nerissa* of the Furness Withy Line, accompanied by Miss Ruth Walker Brooks, artist and daughter of our beloved late Dr. Harlow Brooks, and Mr. Arthur vB. Menken, expedition photographer.

We returned on the same steamer and arrived in New York City on the twenty-fifth of May. During this short time we were able to make further observations on the guacharo bird in Trinidad; to observe and record the strange method used in Barbados to catch flyingfish; to study and make motion pictures of the hoatzin on the Canje Creek in British Guiana; to collect, at the request of the Curator of the Georgetown

Museum, complete material for a hoatzin habitat group; and finally to make camp at Kaieteur Fall, two hundred miles in the interior. At this place we collected and photographed and Miss Brooks modelled four Indian heads. We photographed from the air Kaieteur Fall and the surrounding plateau and jungle, the first pictures of the kind ever taken. In addition I was able to collect a few live birds and animals together with preserved specimens of interest to the Zoological Society and the Department of Tropical Research.

Through the generosity of a small group of friends two-thirds of the trip was financed, while the remaining third was derived from lecture honorariums. Our sincere thanks for a multitude of courtesies are due to the Honorable E. J. Waddington, Colonial Secretary, and to the officials of the Furness Line.

During the southbound trip of thirteen days the *Nerissa* made ports of call for exchange of freight and passengers at many of the Virgin, Leeward, and Windward Islands. St. Thomas, the first harbor, was welcome after five days of tossing at sea. I was impressed with the marked lack of administrative efficiency of the Virgin group as compared with the conditions in British islands. In St. Thomas, we viewed beautiful Mafolie and drove past Bluebeard's Castle, where the pirate is said to have lived with eighteen wives, while across the valley we could see the castle of Blackbeard, who was reputed to be a bachelor. We visited a young

and thriving Botanical Garden which Mr. Maurice Petit had started as a hobby two years ago. He showed us his experiments in propagating plants and shrubs from neighboring islands. Numerous color varieties of hibiscus had been produced and were then in blossom as a result of successful crossings. On our departure, Mr. Petit presented to the expedition a four-inch gopher tortoise (*Testudo denticulata*), known to be four years old. We named it Maurice, after the donor, and it was the first of our animal collection. On our northbound stop at St. Thomas, Mr. Petit sent to the Zoological Society two more of his tortoises, a four-inch specimen and one of eighteen inches which he thought was about fifty years old. Mr. Petit remarked that this tortoise is becoming very rare in the islands, which is the reason for a group being cared for at the Botanical Garden in St. Thomas.

After leaving St. Thomas the Caribbean became calmer and bluer as we passed the ever more wonderful succession of fascinating and colorful islands. At St. Kitts we drove to the summit of Brimstone Hill, and there wandered through the massive fortifications reminiscent of red-coats and pirates. On my last visit there with Colonel and Mrs. Chance, a family of little African green monkeys scampered out from the entrance of a dungeon, but this time

there was only a band of little native black boys to surprise us.

At Antigua, the seat of government of the Leeward Islands, we lacked time both on the southbound and northbound stops to see with ease the outstanding place of historic interest. I was particularly anxious to go to Shirley Heights, named after my forefather, Major General Sir Thomas Shirley, twice Governor of the Leeward Islands. But with a mad drive in both directions over narrow, rocky, winding, donkey-cart roads we had exactly five minutes in which to view these memorable relics. Had it not been for the kindness of the launch captain we would have missed the last boat to the *Nerissa* for, according to schedule, the ferry had left. Shirley Heights is twelve miles from St. John's, the capital of Antigua, and overlooks English Harbour, with its famous dockyard where Nelson refitted his battleships during his command of the Leeward Island Station. On these hills, are ruins of the military batteries and barracks with many of the markers still legible. The old "Look-Out" commands a sweeping view of English and Falmouth Harbour, a bay within a hidden bay. This was once the stronghold of the West Indies.

During two days in Barbados we fished with the flyingfish fleet at a tiny hamlet on the eastern coast. Here, at Bathsheba, the natives live

entirely on what they catch in the sea. In March, April, and May when the flyingfishes are spawning the natives bring in large numbers, while at other times they are seldom caught. This is said to be the only spawning season. The small fleet of stout boats is built on this rugged rock-strewn bay and manned by husky blacks born and raised by the sea.

With them one morning we waded knee-deep to a flat, water-washed rock and climbed into a boat which was poled and guided clear of the breakers. Quickly the sail was hoisted and the stiff breeze carried us five miles to the nearest area beyond the



Crumbling walls are all that remain of the military barracks on Shirley Heights, Antigua, once the stronghold of the West Indies when Nelson commanded the fleet.



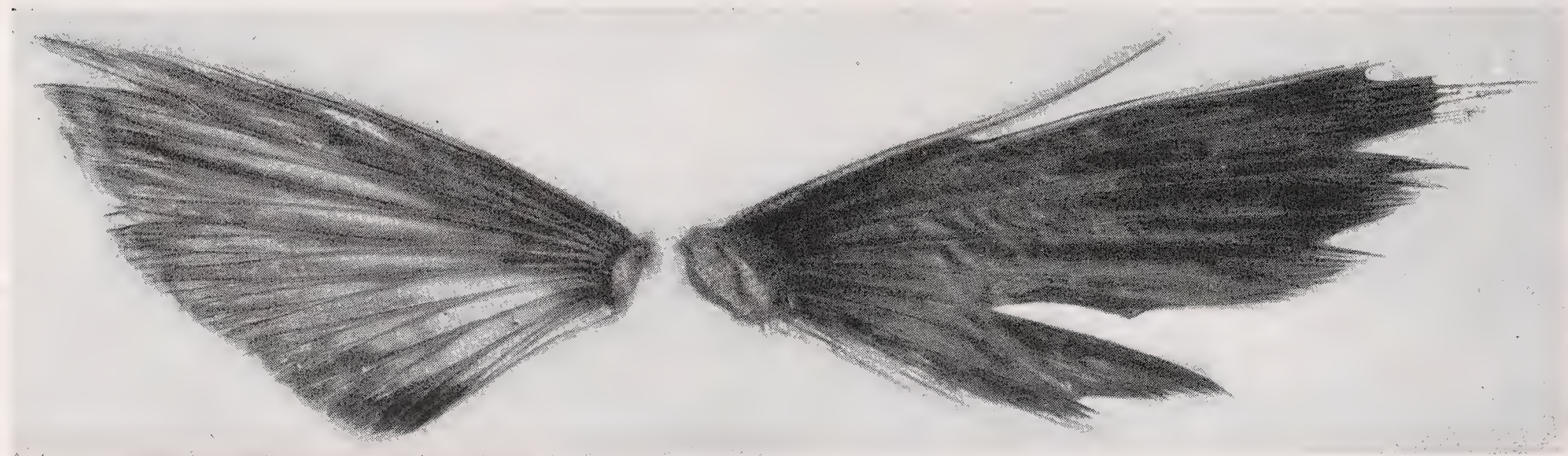
(Upper left) Flyingfish can be caught readily enough by hook and line baited with bits of flyingfish. (Upper right). While fishermen on one side of a boat are taking flyingfish by hook, they may often be scooped up, a dozen at a time, as they swim near the surface on the other side of the boat. They are attracted by the lure on the end of the line that may be seen cutting across the lower right corner.

(Above). A market woman holds up the common type of clear-winged flyingfish. (Right). A mass of fresh flyingfish eggs. They are a glistening gold color, held together by elastic fibrils.



reef where flyingfish are usually abundant. Here we sighted several skimming the water in the distance and immediately the sails were dropped and the prepared lure heaved away on the end of a light rope. The lure is a husky plank about a foot and a half long with a heavy wisp of straw tied on one end. Mixed in the straw is a mass of flyingfish eggs. These easily become entangled and remain in the straw because of the sticky elastic fibrils that connect egg with egg. The fish-

up immediately and our first flyingfish was caught on a hook and line. From now on the round net was used to scoop up many at a time as they lazed near by, picking up morsels of their brethren of yesterday. Several hours passed and we realized through unrelated sources that the sea and wind had been making up. As our tiny boat tossed about, it was with difficulty that we retained upright positions and continued to take pictures. Once we



The wing at the left is that of the common type of flyingfish caught at Barbados, speckled gray, with a light spot at the base. At the right is the wing of a rare type, only one of which was found in 10,000. Its color is jet black.

ermen believe that the lure helps to attract the fish, which ordinarily wrap their eggs around a floating mass of sargassum weed. Next a basket, holding about a dozen flyingfish, is swashed up and down over the side and at the same time an individual fish is scaled into the sea and finally cut up into small pieces and thrown overboard. Then a whole flyingfish is threaded on a giant hook and tossed away in the direction of the lure. Following these preparations a net is stretched and rigged on a round frame about five feet in diameter and held in readiness.

For a few minutes our crew became motionless and silent and I asked "What next?" Our captain answered that now we must wait and watch and added that it is often half an hour or more before the flyingfish come. It was about fifteen minutes when the first one slowly and calmly swam, just below the surface, from the direction of the lure to the side of the boat. The wing-like fins were folded close to the side and motionless, and propulsion was by slow graceful undulations of the body. More and more appeared as bait was thrown over the side. Then a small hook, baited with flyingfish flesh, was dropped to the surface. This was snapped

were almost tipped overboard, cameras and all, and Arthur remarked that the next time he went fishing for flyingfish it would be on nothing smaller than the *Queen Mary*! We pulled in the lure, around which many flying-fish still played, raised the sails, and soon were shoreward bound.

During the height of the season the fleet of deep-hulled boats comes home filled with flyingfish of the same species. Only rarely is there a different species and occasionally a sailfish and shark are caught. The fish which I saw in the catch on April 11 were all approximately six inches long and of a four-winged species (*Hirundichthys affinis*). One day we watched the fleet blow in from horizon to breakers and there drop sails and toss overboard weight after weight while tiny naked black boys swam to guide the boats over the rocks to shallow water, where all hands helped to beach one boat after another. In the catch was but one exception to the otherwise pure culture of a single species. This flyingfish was almost twice the size of the common species and weighed about two pounds. It had a much heavier body, with jet black wings (*Cypselurus cyanopterus*) and was a



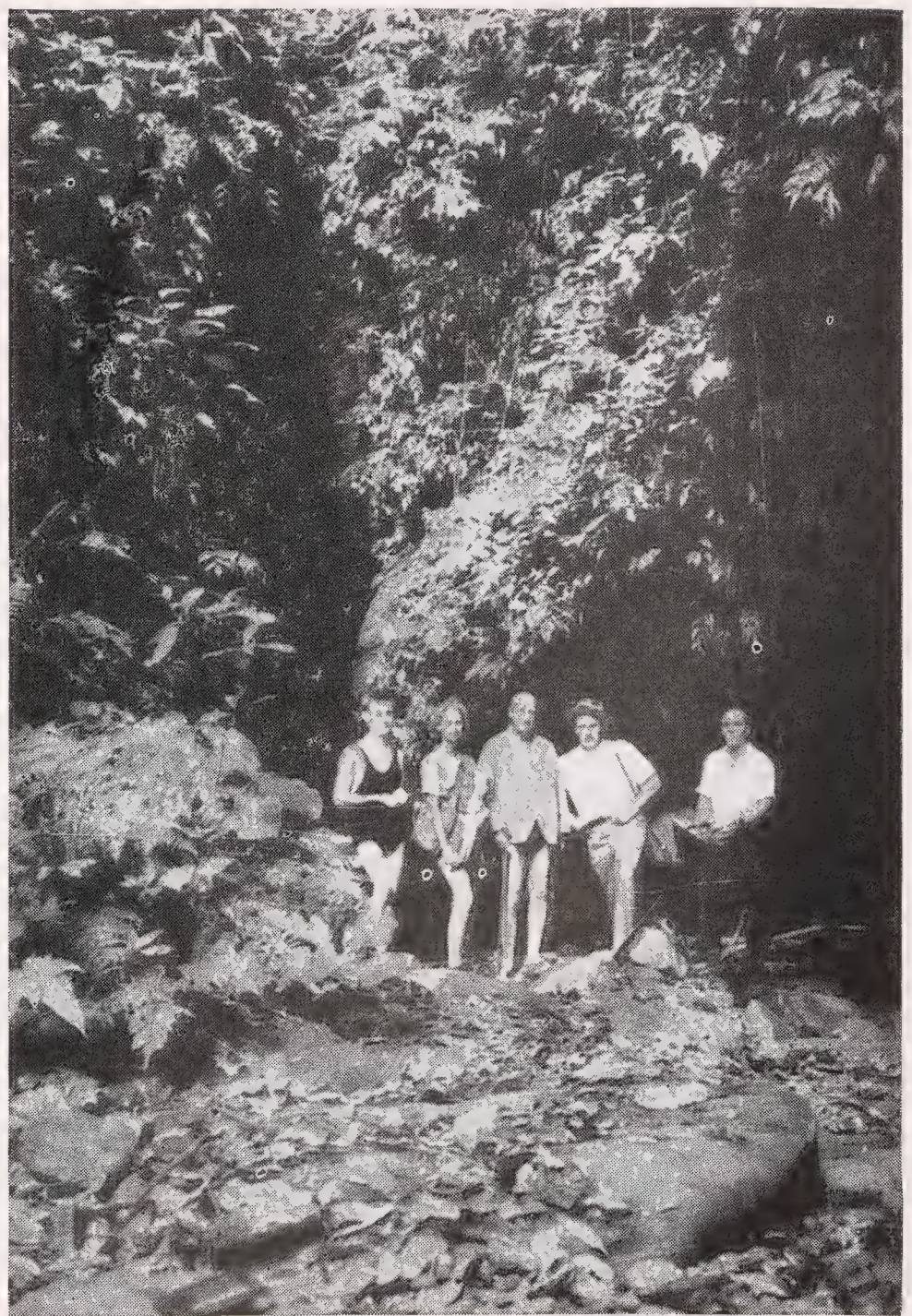
High seas made it impossible to enter the black mouth of Huevos Cave, where the guacharo birds have their nests.

breeding female. The fishermen, at Bathsheba, do not recognize it as a flyingfish and call it "Guianman" (spelling from native pronunciation). They say it is preferable to the common species because of its size and flavor. This larger, black-winged fish may be an open-sea species, one that only rarely approaches even the outer waters of an island, or perhaps it is a seasonal migrant in this part of the Atlantic. The proportion of the two species in one catch of over a half dozen boats was approximately ten thousand to one. All the fish were spawning and ripe, and masses of glistening yellowish eggs with slender crystalline connecting threads were everywhere. There was no doubt that this was the height of the spawning season and that the locality was off the shore of Barbados. I could not discover whether the natives used the roe, but the flyingfish were a delicacy. During the short stops in the other islands, I saw no flyingfish in the markets and was unable to learn whether they were ever caught in numbers or recognized as a table delicacy.

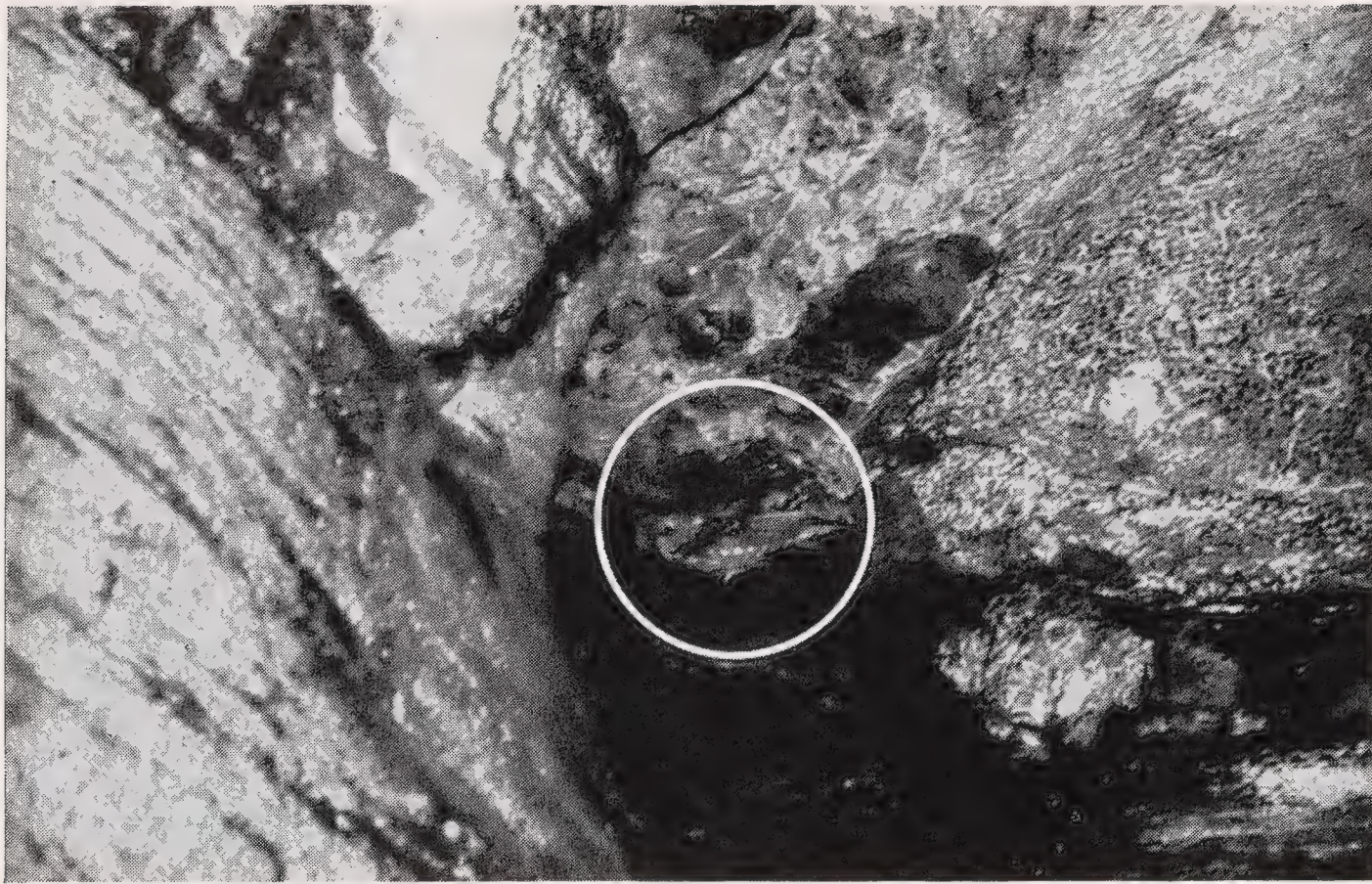
At dawn on the morning of April 12 we slid through the beautiful Boca of Trinidad, leaving behind the rough waters of the Caribbean. The

long range of interfolded hills was mirrored in the calm blue of the Gulf of Paria, the same expanse of water which Columbus thought arose from the river which sprang from the Tree of Life mentioned in the Book of Genesis. To starboard, a school of dolphins bounded toward the bow of the *Nerissa*, in the exact spot where, a decade ago, I photographed these graceful mammals as they broke the surface before the bow of the *Matura*.

It was Easter Sunday and Port-of Spain was quiet and serene in contrast to its bustling week-day atmosphere. Arrangements having been made by our friend Mr. Guppy, we set out to explore the Guacharo Cave on Huevos Island. This is one of the few remaining colonies of the guacharo, or oil bird, which is known from only a half dozen isolated spots in the world: Trinidad, Venezuela, Colombia, Ecuador and British Guiana. On my previous visit I had studied this rare protected bird and,



At the entrance to Arima Gorge (L. to R.): Mr. Johnson, Miss Hollister, Prof. Ulrich, Mr. Menken, Mr. Meyers.



The color of the adult guacharo blends almost perfectly with the dark brown of the rocky ledge and makes it difficult to find and photograph the bird on its nest.

with permission, collected from the Arima Gorge a number of specimens, eggs, nests, and food for an American Museum habitat group. At that time I was not equipped for photography.

Motoring from Port-of-Spain along the northwestern shore we saw the wrecked clipper-ship which a few hours before had crashed while attempting a pre-dawn take-off, bound for British Guiana. We were thankful that the *Nerissa* had made it possible for us to journey direct to our destination, and that our reservations on this flying boat had consequently been cancelled.

At a small bay near the northwestern peninsula, through the efforts of Mr. Carter, a member of the Field Naturalists Club, a diminutive pug-nosed motorboat was chartered and the boatman, a native who knew the shores of Huevos, was also persuaded to go along. This was accomplished only after I did not insist on entering Huevos Cave. The passage near the cave is dangerous and recently his boat was battered and wrecked there. As it was not only a holiday but Sunday, boats were at a premium and natives not interested in working and there was neither choice of crew nor craft. We plied along the irregular shore whose hills were dotted with canopied trees in full yellow bloom, and the many baylets and coves were gay with bright colors of boats and bathers. Chugging between the mainland and Huevos the swell and

the cross currents seemed at times almost too much for our short-nosed, top-heavy craft.

Finally we reached Huevos and landed at a stelling below an attractive Robinson Crusoe camp. Although uninvited guests, we were given a cordial welcome by Mr. and Mrs. Boos. Here again I was warned that the season and the sea were against entering Huevos Cave. Our host sent his native boy, who knew the location of the Guacharo Cave along with our two boatmen. But as soon as we rounded the point and skirted the northern, treacherous

side of the island, I gave up my last faint hope of exploring and seeing and studying this colony of birds. The swell was mountainous and it would have been suicide even to attempt to transfer into the small row-boat which we towed. Near the shore the waves broke high and smashed into heavy spray and foam on the jagged, half-submerged boulders below the barren cliffs. Fortunately our boat was lighter by two companions who remained behind with our hosts. As it was we shipped water while we wallowed in the heavy sea just off the entrance. Our return to the mainland was even rougher than that of the morning and at this time our boatman admitted his anxiety for the hull of the boat, which was pounding on every wave.

The following day (April 13) our good friend, Professor Urich, joined us on a trip to Arima Gorge. With the experience of yesterday still fresh, a land expedition was welcome. This would cause less anxiety for the delicate cameras which had important work ahead in the interior of British Guiana. At Springhill House, high in the Arima Hills, we donned bathing suits and knapsacks and set out for the Gorge. On descending to the deep-cut bed of the river we saw on a rock, just before the entrance to the gorge, an old coat and tattered shoes which were closely guarded by a gaunt-looking would-be hound dog. At the same time harsh voices echoed, louder and louder,

from within the gorge and two men emerged carrying dirty torn knapsacks which contained six dead young guacharo birds. They were all the same size and of that age when layers and layers of fat cover the body before it is feathered. This fat is used by the natives instead of butter. There was very little down on the nestlings and the stubs of large feathers were just appearing. Yesterday the gods of weather and waves had hindered our studies and today marauders had preceded us by a few minutes! While Professor Urich questioned the men, we examined and confiscated the dead birds, and photographed both them and the robbers. The pictures and specimens served later to win the case in the Arima Police Court, the lawbreakers not giving their true names until this picture was exhibited. Professor Urich, and all who care about bird and game conservation, hope that this will serve as an example for the future and help to give this rapidly decreasing bird a chance to remain a while longer among the living rather than the extinct birds of our age.

It was interesting to find again the first nesting place just within the entrance, where by special permission, I had made my collection ten years ago¹. But the flat, round nests were almost deserted as were the other colonies farther through the gorge. These birds of nocturnal habits had been frightened away from their nests by the robbers. We found only one egg and one very young tiny nestling in the first colony. I heard a constant metallic chirp from a tiny frog (*Phylllobates trinitatus*) that was difficult to find because its color blended so perfectly with the mottled dark brown of the walls of the gorge. This song I heard only at the entrance.

Fearing that all our chances had been ruined, Johnson and I made a preliminary trip through to the extreme lower end before risking cameras on a fruitless journey. Travel through the gorge was a scramble to retain an upright position,

because of the unbelievably slippery rocks, covered with rushing water. Here even bare feet were not to be trusted and we often slid and plunged with the water into deep, amber-black pools below. In our first excitement over the plight of the birds we had gone into the gorge forgetting either to take a ladder or ask to have it sent after us. Consequently the upward climb was difficult and treacherous and my muscles felt as though they had been unstretched since the last climb in this gorge when the ladder had been washed away!

Near the lower end we found a second colony of nests high up on the wall and entirely out of reach. This was the exact location from which ten years ago, I had caught the half grown bird², which was the first to feed and live in captivity. As we rested, we suddenly heard the adults approaching from up the gorge with their characteristic *k-e-e-e-k*. Six birds swooped from around the last hidden bend of the meandering chasm. We caught their peculiar cockroach odor from the fanning of their wings as they saw us and circled around before alighting.

In 1926 there were about thirty adults in this colony and now only six were seen. As we watched these graceful chestnut-brown birds, silhouetted against the narrow light-filtered slit

¹ See the *Bulletin* for September-October, 1926, Vol. XXIX, No. 5, "The Guacharo or Oil Bird of the Arima Gorge."

² A picture of the young guacharo may be seen in the *Bulletin* for September-October, 1926.



This is one of the dead guacharos taken from the poachers at the mouth of the Arima Gorge. Note the thick padding of fat that is characteristic of the nestlings.

of the gorge, the tips of their great wings seemed to spread from wall to wall. After the birds disappeared on their nests, we clambered back to the upper entrance and then started to carry photographic equipment to the nesting place at the far end. Motion pictures were impossible, due to lack of light and insufficient time to establish a lighting unit. Our flares had become damp and after they gave us a hot shower bath of sputtering sparks we abandoned this method of lighting. But with our human-supported rickety ladder and several flash bulbs, which did not disturb the birds, photographic miracles were attempted.

The low-lying coast of British Guiana was sighted early on the morning of April 16 with only a day at sea after leaving Trinidad. After two days in Georgetown, the capital, where arrangements and outfitting were completed, we started inland with Kaieteur Fall as our destination. Only because of complete cooperation, both official and unofficial, was it possible to depart almost immediately for the interior. But even during this brief stay it was obvious that Georgetown had changed in the last ten years and now is a clean, happy, busy city, welcoming more and more visitors. Here we roamed in the famous Botanical Garden with Mr. and Mrs. Waddington, to whom not many months before I had bade farewell in Bermuda on their departure for British Guiana. This Georgetown Garden is one of the most beautiful in the world and a paradise for birds and exotic plants.

Early on the morning of April 18, we crossed the Demerara by ferry and the eighteen-mile stretch between the Demerara and Essequibo by train. From the windows we saw lush, wet, rice fields, herds of fat cattle and a great variety of wild birds. Blue herons, with immature ones wearing white plumage, and jacanas, were everywhere in the marshes and on the fences and posts were turkey vultures and white-breasted hawks. Late in the afternoon our river boat reached Bartica, forty miles up the Essequibo. Here the modest Hotel Moderne is now the largest building in this quaint little village, which has but a single main street, even now only a narrow dirt road. A friendly little Beeza monkey, (*Pithecia monachus*), reached out on the end of a string and chattered as we patted and admired his long coarse gray fur and huge

bushy tail. He had been brought from the Brazilian border by his Portuguese owner.

From Bartica the next hundred miles of our journey was by Ford trucks over an amazing trail recently completed by the Government and cut through the heart of the forest between the Mazaruni and Essequibo rivers. In 1926 I tramped over the beginning of the road at Bartica but at that time work was carried forward so slowly that the jungle sprang up and closed in behind the road makers.

All day we travelled on through the forest wilderness, averaging about ten miles an hour, and I wish we could have moved slower because there was so much to see. Birds were more numerous during the afternoon and thrushes, finches, and tanagers flew before us, and shy jungle hens, the Guiana chachalaca, disappeared into the underbrush. Several times I saw a number of slate-black swallow-winged puff-birds perched high in the tops of dead trees. These were old friends but no longer deceived me as to where they lived³. We arrived at Garraway in the late afternoon, having made the hundred-mile run in twelve hours, and there stayed the night in the rest-house with efficient catering by Rock. This was the same man who was cook in 1921 when Dr. Beebe took Mrs. Theodore Roosevelt through to Kaieteur Fall.

The following morning (April 20) it was overcast and foggy when we again set out in the trucks for a short run of six miles to Kangaruma, travelling around a difficult cataract. Here a family of Patamona Indians from the Kaieteur country joined us as carriers.

In a short time everything was transferred from the trucks and placed into two long boats, each equipped with an outboard motor and steering paddles. These two boats made a memorable picture, loaded to capacity with crates, boxes and bags and, on top of everything, people of three races and several brace of live, naked-neck chickens which took great interest in their surroundings. With the two boats lashed together we journeyed up the meandering Potaro and just before noon reached Amatuk Rapids where everything was portaged around and loaded in one boat above the rapids.

Here in the midst of this tropical wilderness I was suddenly reminded of my aquarium tanks

³ *Bulletin*, July-August, 1927, Vol. XXX, No. 4, "The Secret of the Swallow-winged Puff-bird."



The government cut a motor trail 100 miles through the jungle between the Mazaruni and Essequibo Rivers, but travelers frequently have to stop and clear fallen trees or encroaching vegetation from the path. The surface of the trail is loose sand.

in New York City, for in a shallow pool of surface-water high above the river's edge was a school of both young and adult red-tailed rivulus fish. On my down-river journey I captured a number of these beautiful little "tropicals," and they survived the return trip to Georgetown in a pail of water and were still living on the day I sailed. They are a difficult fish to transport because of their desire and ability to jump and climb out of water and to stick to the side of any receptacle.

The slopes of the gradually rising mountains beyond Amatuk were covered with gaunt dead

trees burnt during the terrible drought and the fire of 1926. Now everything was green and luxuriant and everywhere along the river banks trailing vines, shrubs and trees were in bloom. Serpent-like roots of aroids hung straight down to the water like ships' rigging. Many were sixty to seventy feet long. We found the rare rust-brown flowers of the recently discovered shrub, *Cephaelis potaroensis* Sandwith. Only a few months before an English botanist collected this for the first time. I saw it only in this one place which was the locality from where the original type specimen was collected.



First glimpse of Kaieteur Fall—the flash of white water a long way off, partly hidden by the dark green shoulder of the hills that line the river. Three times during the water approach to the fall it is briefly visible and then one of the innumerable bends withdraws the vision. The cascade can be heard long before it is reached.

The rainy season in British Guiana broke six weeks ahead of schedule and consequently the expedition was constantly deluged as it pushed up the Potaro River. One night the rains caused the river to rise six feet, and the next morning the boat was sunk completely out of sight. Fortunately all equipment had been unloaded when it was tied up for the night and a little bailing put everything right.



Because of the spasmodic rain, photography was possible only for about two hours a day, and several times it poured all day long. Negatives took three days to appear dry and even then they stuck to the filing envelopes.

At mid-afternoon our outboard motor gave us great concern and by night-time it could no longer be persuaded to run more than thirty seconds at a time. Constant repairs helped very little and when light disappeared it was impossible to work on it. So I decided to make camp for the night with a family of Indians on the upper side of the Waratuk portage.

Early the next morning the Potaro was never more beautiful and three times we had glimpses of a small portion of the brink of Kaieteur Fall many miles beyond. That night we were at Tukeit rest-house beyond which the river is not navigable. At five o'clock the following morning the first loads started over the trail toward Kaieteur. By mid-afternoon our two thousand pounds of food and equipment had been carried to an elevation of twelve hundred feet and five miles on to Kaieteur plateau. The trail winds upward and upward but once above the very steep and rocky mountainside the winding path is open and through tall trees. The plateau might have been another world, it was so different from the country through which we had come. Underfoot it was rocky and pebbly, instead of sandy as in the lowlands, and here and there were large water-worn puddingstones.

Surface water was everywhere and we sloshed, ankle deep, through rivulets and puddles filled with tadpoles and frogs. The roar of Kaieteur Fall grew louder and finally we stood at its brink. Here, two hundred miles inland, the amber-colored Potaro plunges over a jagged cliff, and when it strikes, 741 feet below, the water has become spray, which when it rebounds is a white filmy mist. Kaieteur is five times higher than Niagara and one of the highest and most beautiful waterfalls in the world.

Rain poured during our first morning in camp and we quickly turned tiny cubby holes of the three-room rest-house into work places for photography, collections and sculpturing. During seven days at Kaieteur we studied, collected and photographed the life of the plateau. Ruth Brooks modelled the heads of Indians, copies of which have been requested for exhibition at the Georgetown Museum.

We saw and photographed Kaieteur in all phases of its ever-changing personality. In motion picture film we used both large standard 35 millimetre size and small size or 16 millimetre. In the latter both black and white and color film were used. Although the initial results of the color film was very pleasing, the color values are now fading as the result of the tropical climate. One type of colored still photographs is changing in the same way as the motion picture film, but it has been a help in identifying our herbarium specimens from Kaieteur plateau.



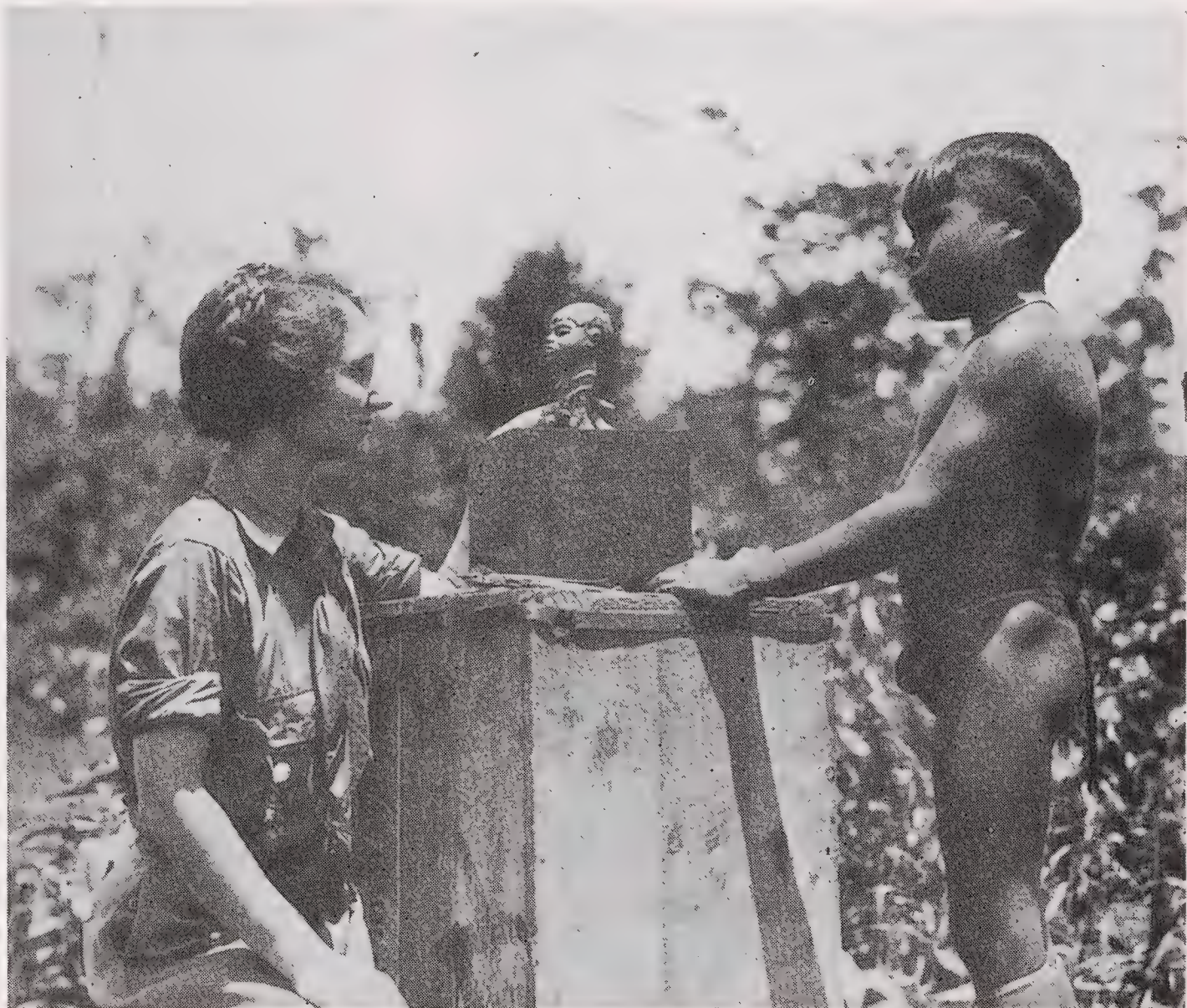
The expedition's porters arrive at Kaieteur Plateau, at the very brink of the great fall. The northern side of the plateau is open country with a sparse growth of big trees, while on the opposite bank of the Potaro River there is dense jungle which extends to the Pakaraima Range in the far distance.

Through the courtesy of Dr. Mees of the Eastman Kodak Company, a new colored film used in a Leica camera was tried in this country for the first time. The individual frames mounted between glass have made beautiful lantern slides and the color to date has changed very little.

Every afternoon from three o'clock on, the plateau rang with the song of frogs, the loudest

of all coming from a *Leptodactylus*, but I heard no song of the golden frog, *Hyloxalus beebei*, living in the giant bromelias, nor did I find spawn or tadpoles. Dr. Beebe relates that on the day he spent at Kaieteur in the month of February many years ago he heard the frogs calling in the morning and tadpoles were abundant. I found seven kinds of frogs were

Alicot, a young boy of the Patamona tribe, posed patiently for Ruth Brooks while she modelled his head. From the miniature model she made in the field, larger heads were shaped after she returned to New York. Miss Brooks found the head types of British Guiana Indians more Oriental in feeling than any of the Indians she has modelled in the southwestern United States.

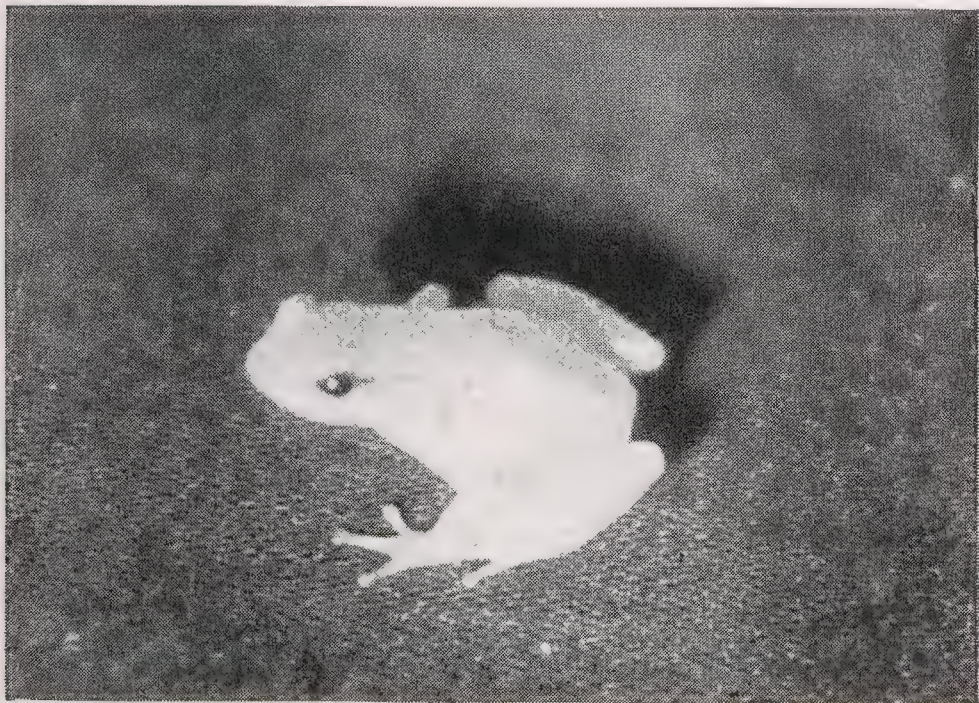




These giant bromelias on Kaieteur Plateau are the only home, so far as is known, of a miniature golden frog.

numerous and several were breeding, and tadpoles abundant in the surface water.

According to arrangements with Arthur Williams, an American pilot and owner of a Wasp-Ireland amphibian plane, he and his co-pilot, Harry Wendt, joined us the day after our arrival at Kaieteur. The plane landed and tied up in a tiny muddy cove about a quarter of a mile above the brink of Kaieteur. In the course of a



The golden frog—a tiny creature less than three-quarters of an inch in length.

week we had five and a half hours for aerial photography on the clearest days, between rains and heavy, low clouds. During this time we flew and photographed the Potaro River from above the brink, shooting over Kaieteur Fall and down the Potaro Gorge to Garraway. Later we flew and photographed a neighboring escarpment to the northwest of Kaieteur plateau and saw the Princess Marina and the recently named King Edward VIII Falls. We also counted more than forty others, having missed many in the beginning until I realized their abundance, which we learned later from maps and authorities were wholly uncharted. These are the first pictures of this kind taken from the air, of Kaieteur and this country in general. Arthur Menken worked under maximum diffi-



Looking down into the heart of a bromelia, where the frog spawns in the water-filled bases of the leaves.

culties in taking the motion pictures with only an open window for aerial facilities. Together with the skill of Arthur Williams in dipping and turning his plane and circling just above these falls this record was made possible.

We were reluctant to leave Kaieteur but this was necessary after a week because of limited time and a prospective journey of several hundred miles to the Canje Creek near the Dutch Guiana border, the haunt of the hoatzin. Apart from this, had we stayed much longer in the in-



Trails of leaf-cutting ants were found near Kartabo. After they merged in the foreground of this picture, the single trail ran through a hollow log and into the jungle for a quarter of a mile to the nest, a large, rounded dome of leafy débris.

terior all our films would have suffered severely because of the rains.

We stayed over one night at Bartica in order to go to Kartabo, the field station of the Department of Tropical Research, where scientific work was carried on for eight years by Dr. Beebe and his staff. I had taken with me to Kaieteur two ancient rusty keys which a black boy had brought to me in Georgetown, saying that they were the keys to Kartabo. "Sonny" had been the youngest mess-boy at Kartabo during its last season, and as he knew how to skin and preserve and collect in the field I signed him on for the Kaieteur trip.

Kartabo Point looked very different from a distance than it had in the past and I could not locate the laboratory building behind the bamboos. I temporarily dismissed this because it was raining and the growth had no doubt grown up and hidden the house from sight. But soon after landing the real answer was found. Not only was there no front or back door to fit the keys, but no building! Only the four support posts remained. In 1926 the building was badly damaged by termites and during the interval these insects had completed their work of destruction.

A concession of this whole tract of jungle between the Cuyuni and Mazaruni rivers has been granted to a gold mining company whose buildings were located near the site of the former laboratory. Kartabo Point has been cleared and made level, but the old circular sloth pit had remained a mystery and had been left untouched until our arrival.

On the sixth of May we reached New Amsterdam, a small town on the coast near the eastern border of British Guiana. All during our first day it rained steadily but we went up the Canje Creek on a scouting and collecting trip for hoatzins. By the courtesy of Mr. MacNie, the District Commissioner, and Police Inspector Matthey we were given the use of the Police launch. We found the first colony of hoatzins in the same locality where they were ten years ago, above the stelling of the sugar mill. From here on up the Canje, groups of birds were seen perched on the branches of the bunduri pimpler and bamboos. I found nesting birds, eggs, and young of three ages ranging from very young to half-feathered stage where the ancestral claw was beginning to be of little use. Several birds of the year were seen during the afternoon and could not be dis-



(Upper left). Behind this tall mucka-mucka is the habitat of the hoatzin on the Canje Creek. (Upper right). This chick is climbing with the aid of its wing claws before its wing feathers appear. (Left). Three young hoatzins on a nest of loose dried sticks. Hoatzins are rather social birds and are found in colonies with nests, all of them built directly over water. The nests may be at varying heights, from a few to many feet above water.



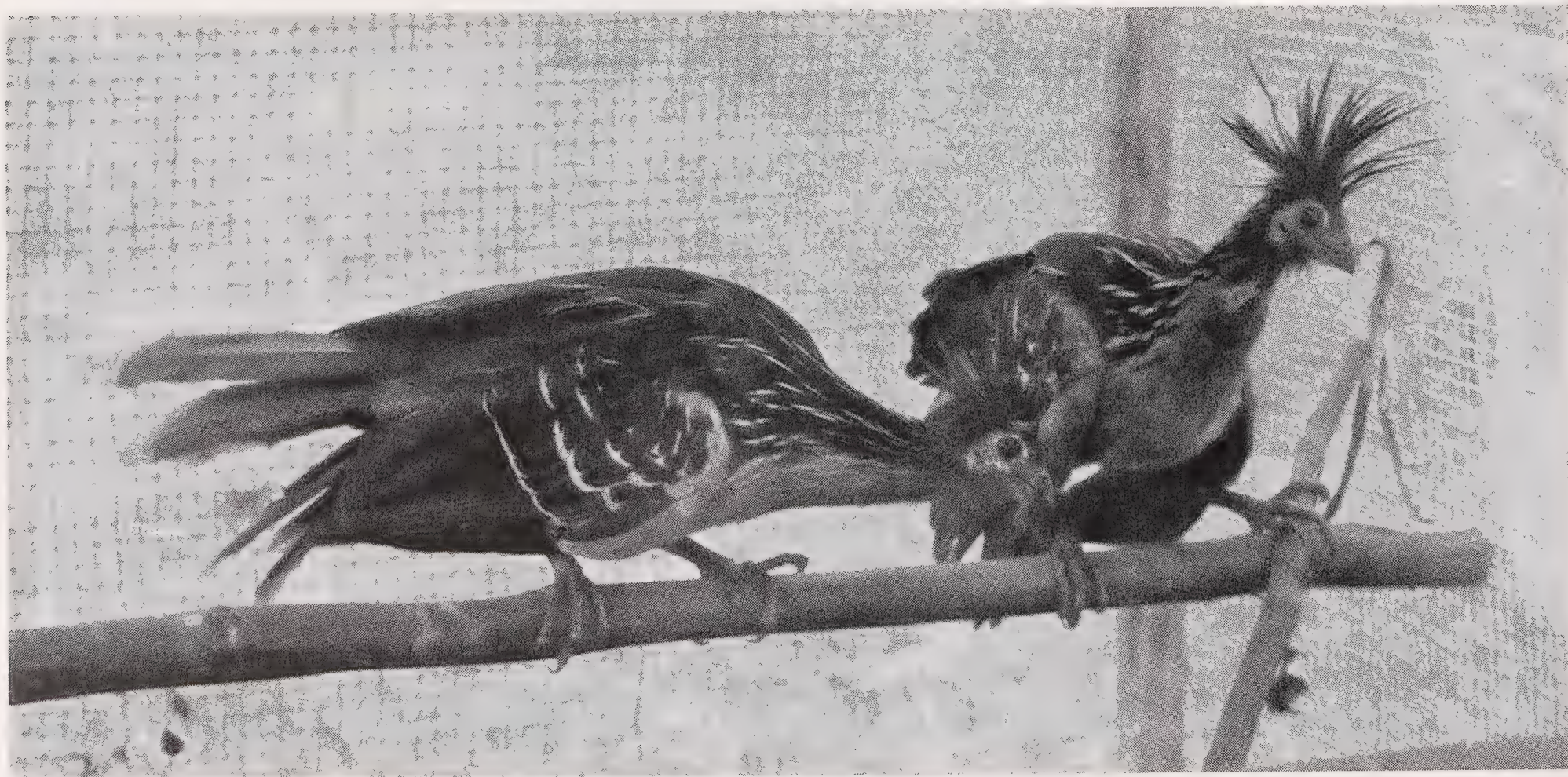
A three-quarters-grown hoatzin, just acquiring its feathers and beginning to use its wings for balance.

tinguished from the adults except by their smaller size. We collected specimens for the habitat group in the Georgetown Museum and at the same time located accessible nests for photography.

A half-grown young bird which I kept for a number of days took kindly to life in a cage but preferred perching on my hand or arm. After several forced feedings it learned to feed itself and was less troublesome than many other animals during those delicate transitional days immediately after capture.

The following morning it was clear and hot and every minute was used for photography and observation of the nestlings. In the afternoon until dusk we concentrated on the more difficult adults along the banks of the Canje. While in this part of Guiana I was disappointed not to find the scarlet ibis in evidence and upon inquiring was told that they were not as plentiful as formerly and were now seen more along the seacoast. It was interesting to see my old aquarium friend, the guppy, in one of its native habitats, the gutter along the main street in New Amsterdam. In many of the fish the color of the tail was a solid peacock blue, a color not often seen in our tank-bred guppies.

On the thirteenth of May we sailed with numerous crates and cages of preserved and live specimens, all of which arrived in New York alive with the exception of "Percy," the three-toed sloth. Although one of the slowest moving mammals in the world, "Percy" managed several times to slip his belt and explore the freight holds of the *Nerissa*. Once, after an extended search, we found him sleeping in the front seat of a new Ford V8 bound for St. Thomas. "Janie," our affectionate black spider monkey, was the pet of the ship, from captain to cook, and had more original ideas as to what to do in the next five minutes than any five year old child.



This is how hoatzins look when they have their adult plumage—two full-grown birds that were once kept at the Department of Tropical Research station at Kartabo.



A member of the boundary commission working between British Guiana and Brazil captured this handsome little tayra and presented it to the expedition, which brought it to the Zoological Park. Belonging to the weasel group, the tayra has a head and neck colored about like a silver fox, a body colored like a skunk, and a large orange spot under the chin. The resemblance to a skunk does not end with similarity of body color, either.

List of specimens collected for the New York Zoological Society. These included 33 live birds, 8 mammals, 15 amphibians and reptiles, also preserved amphibians, reptiles and plants from the Kaieteur plateau.

1 Black Spider Monkey.....	<i>Ateles ater</i>
1 Golden Agouti.....	<i>Dasyprocta acouchy</i>
1 Tayra or "Hacka".....	<i>Tayra barbara</i>
1 Ocelot or "Tiger Cat".....	<i>Felis pardalis</i>
1 Silky Ant-Eater	<i>Cyclopes didactyla</i>
1 Ruddy Quail Dove.....	<i>Oreopeleia montana</i>
2 Red-winged Ground Doves.....	<i>Columbigallina talpacoti rufipennis</i>
1 Red-underwinged Dove	<i>Leptotila rufaxilla rufaxilla</i>
3 Gray-necked Tree-Ducks	<i>Dendrocygna autumnalis discolor</i>
1 Lined Seedeater	<i>Sporophila lineola lineola</i>
2 Black-headed Seedeaters	<i>Sporophila bouvronides</i>
3 Blue-backed Seedeaters	<i>Sporophila castaneiventris castaneiventris</i>
1 Pigmy Seedeater	<i>Sporophila minuta minuta</i>
1 Guiana Saffron Finch.....	<i>Sycalis luteola minor</i>
1 Crimson Pileated Finch.....	<i>Coryphospingus cucullatus</i>
2 Blue-backed Manakins	<i>Chiroxiphia pareola pareola</i>
2 Little Yellow-headed Blackbirds.....	<i>Agelaius icterocephalus icterocephalus</i>
2 Guiana Chachalacas	<i>Ortalis motmot</i>
1 Yellow-throated Calliste	<i>Tangara arthus</i>
2 Yellow-bellied Callistes	<i>Tangara mexicana mexicana</i>
2 Spotted Callistes	<i>Tangara guttata guttata</i>
2 Violet Euphonias	<i>Tangara violacea violacea</i>
2 White-shouldered Blue Tanagers.....	<i>Thraupis episcopus episcopus</i>
1 Paradise or Rainbow Tanager.....	<i>Tangara paradisea</i>

3 Vampire Bats. To the National Zoological Park, Washington, D. C.

1 Three-toed Sloth. Skin to the American Museum of Natural History

The Waterfowl Situation

Field Investigators of the Bureau of Biological Survey Report Good Prospects Except for Canvasbacks and Redheads

FREDERICK C. LINCOLN

Senior Biologist, U. S. Biological Survey

TO portray the waterfowl situation as it exists today, it is first necessary to glance backward to conditions prevailing before civilization took up its westward march across the Great Plains. Despite the many excellent works that have been written on that period, it is unfortunately true that even today few persons have more than the haziest notion as to the relative importance of the different regions that have formed the breeding grounds of our migratory waterfowl.

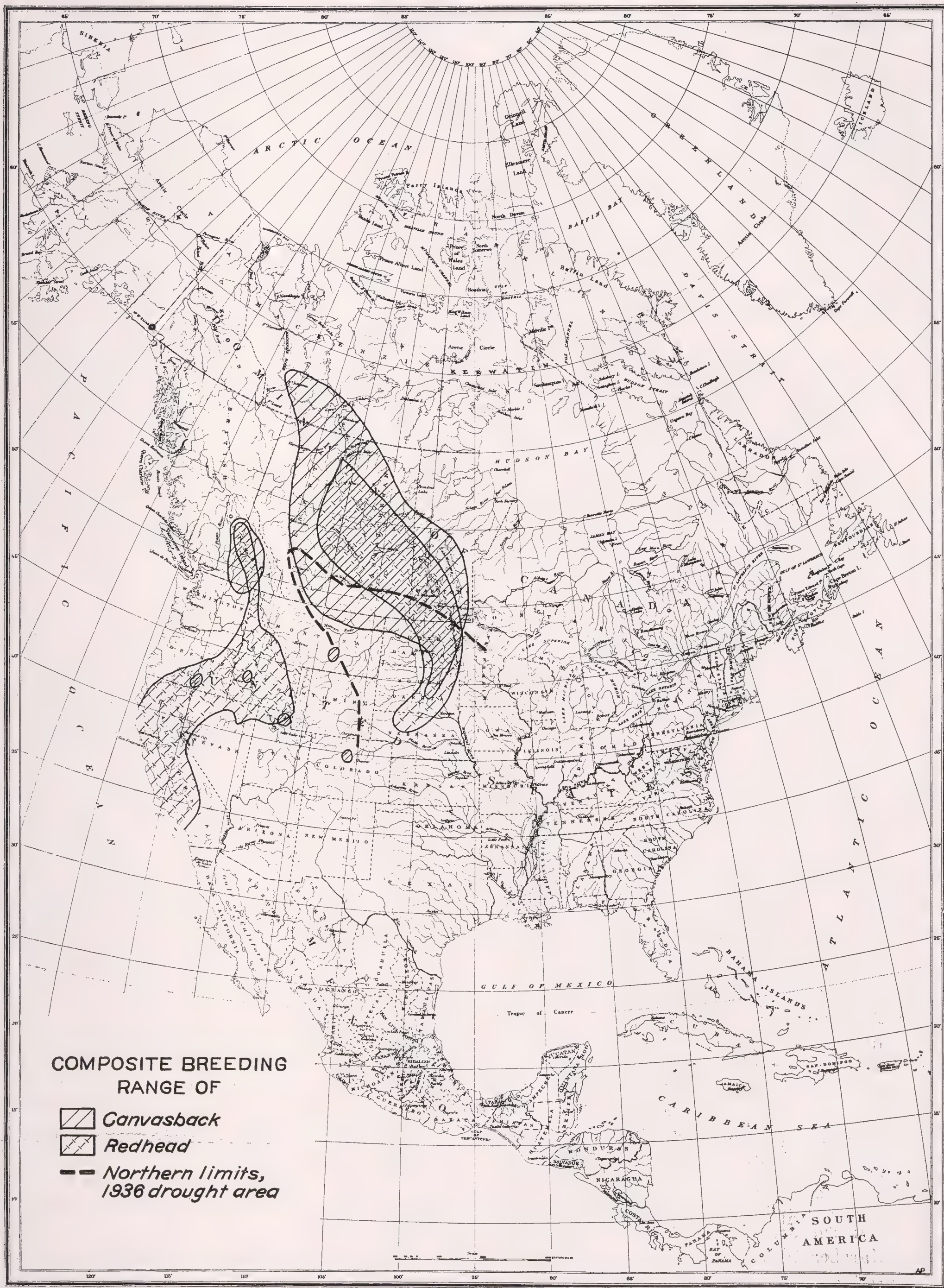
Lack of this information results in such waves of hysteria as when, alarmed by drought conditions over large parts of the Great Plains, hundreds of well-meaning men and women address letters to the President or to the Secretary of Agriculture, petitioning for a complete suspension of waterfowl shooting privileges. On the other hand, many sportsmen are inclined to think of Canada as a vast henyard for ducks, geese, and swans, with the various species breeding indiscriminately all over the region from the Canadian Pacific Railroad north to the Polar Sea, and from Newfoundland west to Vancouver Island.

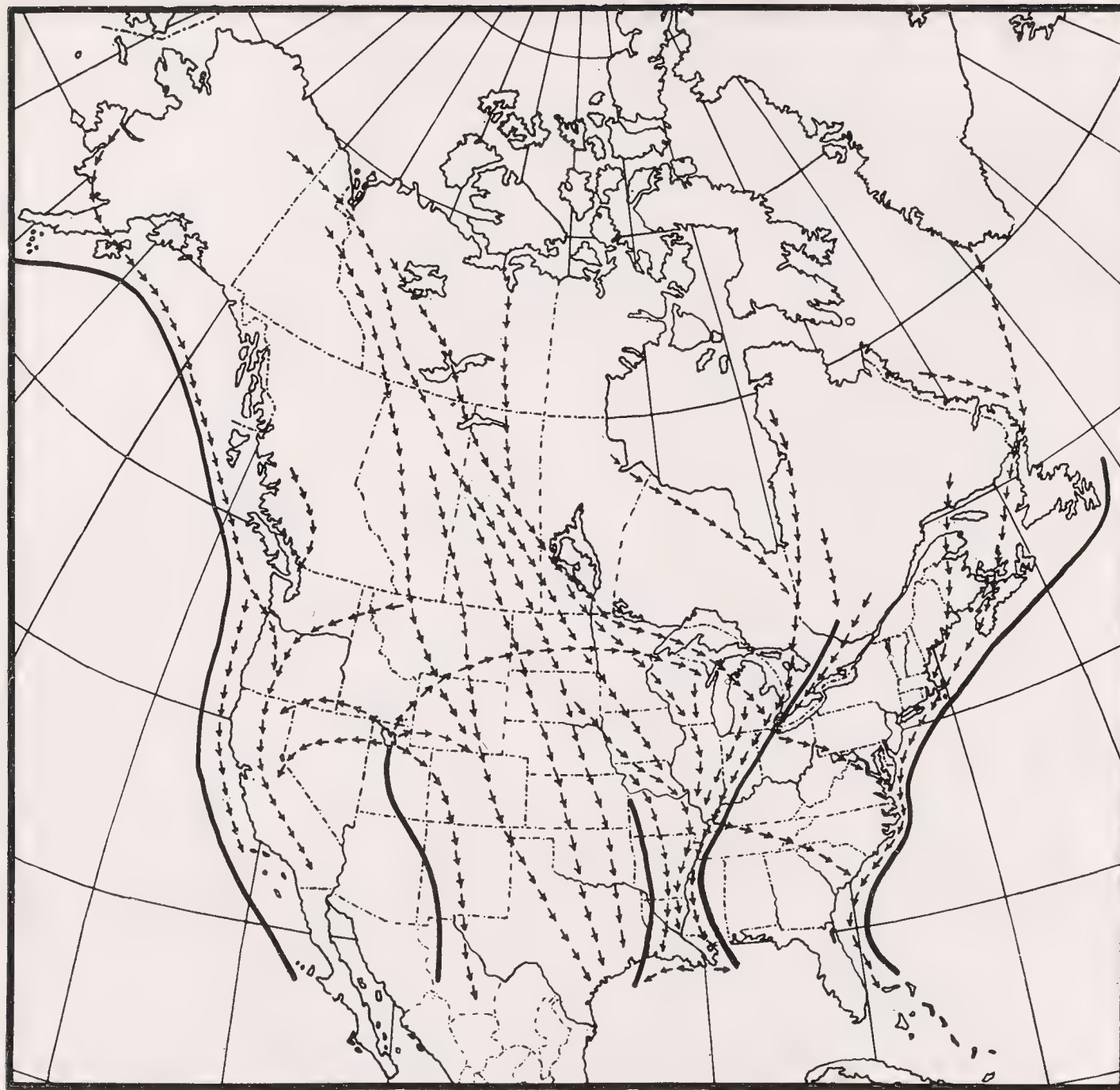
Probably the principal reason for misconceptions with regard to the status of waterfowl is the fact that the average sportsman lacks a real interest in the life cycle of the wildfowl as a whole. Once the ducks and geese have left the shooting grounds with which he happens to be familiar, he does not wonder over-much where they go. With a childlike faith, he expects the next breeding season in the mysterious Northland to replenish in full the supply of all species. Unfortunately also, despite the almost universal interest shown in bird life by the people of the United States and Canada, the number of professional ornithologists in both countries who have a *practical* interest in this group is surprisingly few.

When one comes to study the continental breeding grounds in detail, an enormous potential sectional difference is at once apparent. With the exception of a few blue-winged teal and some of the mergansers, or fish ducks, the eastern part of the North American continent produces no game waterfowl other than the black duck and the Canada goose. By extending this zone into Greenland and the eastern Arctic islands, this meager list may be increased by the addition of the Atlantic brant, the blue goose, and the snow goose. One flight of the black ducks and Canada geese is coastal bred, coming chiefly from Newfoundland, Labrador, the Maritime Provinces of Canada, and New England. Strangely enough, banding data have shown that very few birds from this northeastern flight travel south farther than Long Island Sound or the coast of New Jersey. Another flight of these species, which reaches the Atlantic coast in the general vicinity of Delaware Bay and Chesapeake Bay, has its origin in the interior, coming from breeding grounds in western Quebec, Ontario, and Michigan. None of the pintails, baldpates or widgeons, redheads, canvasbacks, and scaups, which are so important to the sportsmen of the eastern seaboard, are produced east of the Great Plains.

Canadian Breeding Grounds

From the viewpoint of the continental waterfowl supply one region stands out so far above all others that its importance cannot be over-emphasized. This is the great central prairie strip extending from near Great Bear Lake and the Valley of the Mackenzie River in the northwest to the Dakotas, Minnesota, and Nebraska in the southeast. Here two-thirds to three-quarters of the game ducks of the continent nest and rear their young. In addition to supplying the Atlantic Flyway with all its diving species





The heavy black lines on this map show the major waterfowl flyways in North America. Note the northwest - to - southwest flight made to the Atlantic coast from the nesting grounds in northern Canada, and the west-to-east and the east - to - west flights of the redheads that nest in the Bear River marshes of Utah.

Bureau of Biological Survey.

and several important shoal-water species, this great nursery sends its flocks down through the Mississippi and Central Flyways, and to a lesser extent into the Pacific Flyway. What transpires in this region is of concern to everyone. While the figures have been challenged, nevertheless there is reason to believe that even in their primeval condition, the far-flung nesting grounds of Canada and Alaska produced about 85 percent of the waterfowl of North America. Under present-day conditions, even under a reduced abundance of the birds, it is more than likely that this percentage has been increased rather than decreased.

Like all elevated regions, the great chains of the Rocky Mountains and the Sierra Nevada are poor in nesting areas, although the many parks and valleys in Colorado, Wyoming, Idaho, Montana, and British Columbia provide some breeding grounds that are utilized by many species, and of all remaining waterfowl nesting grounds in the United States, the famous Bear River Marshes in Utah are without doubt the most productive. Originally, this claim might have been disputed by the great interior valleys

of California, as the San Joaquin and Sacramento presented virtually an uninterrupted nesting ground from one end of the State to the other.

In Alaska, the great valley of the Yukon River and, to a lesser extent, the valleys of the Kuskokwim and other minor streams north of the Alaska Peninsula are important nesting grounds, but they do not support anything like the variety of ducks that are bred in the Prairie region of Canada. The pintail, baldpate, mallard, and green-winged teal are most numerous. Most of these Alaskan birds follow the Pacific Flyway, although occasionally some wander over into either the Central or the Mississippi arteries of travel.

With all this vast region in its pristine condition, dotted with countless lakes, ponds, sloughs, pot-holes and marshes, the supply of ducks and geese seemed literally inexhaustible, heavily exploited though it was from the time the first white man set foot on the continent. So vast were the flocks that winged their way southward each autumn, that even during the most ruthless of the market hunting days little diminution

was noticed. Even as recently as 25 years ago, the numbers of ducks and geese that reared their broods in the innumerable marshes and sloughs of the Western States and the vast well-watered regions of Canada and Alaska seemed incalculable. No one knows what the continental waterfowl population was, but figures of 100,000,000 and even 150,000,000 have been suggested, and it is probable that both are conservative.

Effects of Settlement

As soon, however, as the first furrow was plowed in the prairies, the doom of important breeding grounds was sealed. Quickly following the plow came the dredge, and in 1922 it was estimated that organized drainage districts in the United States included approximately 75,000,000 acres, a region larger than the combined areas of the Great Lakes, or half again as large as all New England. Not all the drained land was original waterfowl nesting ground, but it is safe to say that fully three-quarters of it was.

Coincidental with the settling of our own North Central States, Canada was developing her granary in the Provinces of Manitoba, Saskatchewan, and Alberta, resulting in the permanent and complete destruction of additional prairie marshes, sloughs, and pot-holes. Fortunately for the birds, only the southern parts of these Provinces are suitable for human abode, and accordingly there is reason to believe that the great region north of the "bush" line will always be ideal nesting grounds for ducks and geese. Our problem is to see that birds are returned to occupy them.

Coupled with the destruction of natural habitat came an increased interest in sports afield, an ever increasing army of hunters equipped with more effective arms and ammunition, and development of rapid travel and good roads, so that there is now quick access to wilderness areas that a generation ago were virtually unknown. Crowded out of their ancestral homes and beset on all sides by human enemies (aside from the crow in the nesting season, waterfowl have no *important* natural enemy), the reduction in the numbers of ducks and geese was coming on gradually, almost imperceptibly, although a few far-sighted naturalists and sportsmen sounded warnings as early as the '90s of the last century.

Official Yearly Surveys

With its duty clearly defined under the Migratory Bird Treaty Act, the Biological Survey has each year studied the problem to the extent of its resources. Working in close cooperation with the wildlife officials of Canada, it makes every effort to get the facts upon which to base sound regulatory action. As resources have been increased the work has been expanded until now the Bureau is in position to obtain more accurate information on the status of North American waterfowl than any other organization in this country.

It is well to state here, however, that no attempt is made to take a "waterfowl census." A census, or actual enumeration, is, of course, impossible with a group so widespread and with such diversified habits as the waterfowl. Numerical estimates of ducks and geese, however, are most useful for comparative purposes, or for showing trends, but the figures must not be taken literally. The use of the relative terms "increase," "decrease," and "no change," however, based on observations made year after year in the same area by the same observer and compared with the preceding season, are dependable and far preferable to an attempt to estimate actual numbers.

The Great Drought

While a progressive diminution of the numbers of ducks and geese has been noticeable during the last generation, it required a major calamity to bring their critical situation so forcefully to attention that remedial measures would be taken. Without gainsaying the widespread damage and suffering that has been caused to the human population by the great drought, to our migratory waterfowl it may be said to have been a blessing in disguise. It has resulted in funds being made available for investigation, enforcement, and restoration, on a scale that for the first time in history approaches adequacy.

The long period of deficient precipitation began in 1915 over hundreds of thousands of square miles of the finest breeding territory in the North Central States and the southern parts of the Prairie Provinces of Canada. With the exception of a slight improvement in 1920, the shortage of rainfall continued to 1934, when all existing records were broken for duration, severity, and extent of territory affected. The

season of 1935 witnessed a general improvement, which all observers hoped presaged a return to normal conditions. This hope was strengthened by heavy snows during the ensuing winter, and the spring of 1936 opened auspiciously. By midsummer, however, drought conditions were again acute, in many regions being more serious than in 1934.

The 1935-1936 Winter Inventory

Study of the data compiled following the fall migration of 1935, gave definite encouragement

sportsmen's organizations. The situation was rendered particularly serious in coastal waters by the worst oil pollution in history. In Long Island Sound, Great South Bay, Delaware Bay, and Chesapeake Bay, hundreds if not thousands of ducks and other birds were destroyed by oil.

Starting early in the season elaborate plans were made for a mid-winter inventory. Utilizing the experience of the previous year, this work was organized under the leadership of the eight regional game management directors of the Survey, each of whose corps of agents was



On board this steamer, the "Northland Echo," a Biological Survey party left Waterways, Alberta, for a survey of the waterfowl status in the north.

Photo by C. E. Gillham.

that our migratory waterfowl were slowly coming back. With reports at hand from nearly 350 hand-picked observers stationed in important waterfowl areas throughout the country, 207 reported an increase over the same season in 1934 at which time only 84 could detect any improvement. Contrariwise, in the fall of 1934, reports of decrease came from 352 observers while in 1935 this number had shrunk to 70. This reversal of the 1935 situation over that of 1934 was a complete vindication of the conclusions of the four field parties that during the summer had operated on the breeding grounds in Canada.

With this apparent gain, the climatic conditions over much of the wintering grounds, particularly on the Atlantic coast, were disheartening. Long continued cold of unusual severity covered natural food supplies with a mantle of ice, and reports of extensive starvation and freezing were numerous despite heavy feeding of grain by Federal and State agencies, as well as by Isaac Walton League chapters and other

augmented by forces from the several State game departments, the Forest Service, Soil Conservation Service, State Colleges, National Association of Audubon Societies, and others. In addition to the regular patrol boats of the Bureau, the "navy" was increased by State boats, and craft of the Coast Guard, and the Bureau of Navigation and Steamboat Inspection.

The Army, the Navy, the Coast Guard, and the Goodyear Rubber and Tire Company furnished airplanes, seaplanes, and blimps, so that practically all important concentration waters were covered not only by surface craft, but also from the air.

The operations of the eight "armies" and the "navy" developed the following information with regard to the waterfowl of the four flyways: with the exception of the northeastern flight, the Atlantic Flyway showed definite improvement, as did also the Mississippi Flyway. The Pacific Flyway showed up a little better than in 1934, but the gain was not great. The

Central Flyway, on the other hand, made a very poor showing, but this Flyway includes the "dust bowl," where many lakes and marshes have been entirely dry, and it was apparent that the birds belonging there were forced to neighboring Flyways or to longer flights to winter quarters in Mexico. Nevertheless, a party from the Survey operating in Mexico during the winter obtained evidence that there was little if any change in the numbers of ducks and geese wintering in that country as compared with the previous winter.

While the mallards, pintails, and scaups appeared in the best condition, the situation with the canvasback and the redhead was viewed with alarm. Early in the fall a concentration of canvasbacks variously estimated from 200,000 to 300,000 was observed by the present writer and others on the famous Susquehanna Flats in eastern Maryland. At the time of the winter inventory these birds had been driven out by ice and they could not be found in any other coastal

waters to the south. Their disappearance constituted a perplexing mystery, although no particular apprehension. Nevertheless, in no other part of the country was any large concentration of this species reported, while the situation as regards the redhead was even more disturbing. The largest gathering of this duck to be reported was a flock estimated at 39,000 in the vicinity of Harlingen, Texas.

The 1936 Breeding Ground Survey

With this background of recent investigations, five field parties were dispatched into Canada for work on the nesting grounds during the summer of 1936. All parties were made up of experienced biologists or game management agents, several of them being men who worked over the same areas in 1934 and 1935 and so could make direct comparisons.

In British Columbia rainfall was abundant except in the lower part of the Fraser Valley. The Survey party worked north through the interior to within 100 miles of the Alaskan boun-



Photo by L. J. Goldman.

When a Biological Survey party goes into the breeding grounds for a survey, it goes prepared to stay awhile. This is one of the Survey's camps near the lower delta of the great Athabaska River in Alberta.

dary, making critical examinations of large numbers of lakes, sloughs, and marshes. The work was started early in June and continued until the first part of August when the majority of the ducklings were on the wing. In summing up their observations, this party, after remaining through the nesting season and correlating all factors, reported a "somewhat better outlook."

Another party operated in southern Alberta and southern Saskatchewan where it met a third party that also covered Manitoba north to The Pas. Both parties covered a region that was affected by severe drought conditions. In Alberta the drought line extended northward east of the mountains, Calgary, and Red Deer, thence northeastward to Lloydminster, Saskatchewan, its northernmost point, and thence southeastward via Saskatoon and Regina to extreme southwestern Manitoba.

In east-central and southeastern Alberta the effect of the drought upon waterfowl was bad, as the spring water in small lakes and ponds resulting from the winter's snows seemed sufficient to attract waterfowl to nest there. As summer rains were lacking many of these areas dried up before the young ducks were on the wing. In southern Saskatchewan, however, ponds and small lakes have for several years lacked sufficient water to make them attractive to ducks, and in consequence very few birds had attempted to nest, most of them apparently going on north to better-watered regions.

Studies were made in Alberta and Saskatchewan of 179 broods of ducklings, representing 13 species. The average number per brood was 6.5 although for several species broods of 10, 11, and 12 were noted. Rather startling was the fact that only one brood, of four ducklings, of the redhead was noted.

Several lakes that supported fair numbers of ducks in 1935 were dry in 1936. On the other hand an occasional area was found in the drought region that carried an increased population. Three lakes in the Saskatoon region were reported to have more nesting ducks than at any time for the last five years. The areas in northeastern Saskatchewan, including the Saskatchewan River country, the Qu'Appelle Valley, Last Mountain Lakes, and the Quill Lakes, were not affected by drought and the waterfowl showed an increase. Taking into consideration the fact that some young ducks

hatched early and were on the wing before drought conditions became acute, the investigators nevertheless concluded during the latter part of July that in the drought area of this Province approximately 10 percent of the duck crop would be lost unless sufficient rain came within a very few days.

The Province of Manitoba was very slightly affected by drought, and important breeding grounds around Lakes Winnipeg, Manitoba, and Winnipegosis, as well as The Pas area on the Saskatchewan and Summerberry Rivers and sections in the western and southwestern parts of the Province, were found to have excellent water and other habitat conditions. On first study of the Delta Marsh south of Lake Manitoba, a decided scarcity of canvasbacks was noted, although this species made a better showing on a later recheck. Reliable observers reported that the largest flight of geese in several years passed through this Province last spring.

In summarizing their report on Manitoba and eastern Saskatchewan, the investigators concluded that there had been approximately a 10 percent increase in all species, "with the exception of the canvasback and the green-winged teal." To these should be added the redhead.

For the purpose of obtaining first-hand information concerning the waterfowl and the conditions affecting them in the basin of the Mackenzie River, a fourth party traveled northward by steamer, canoe, and airplane, and at the time of this writing (August 27) is based at the little village of Aklavik near the mouth of the Mackenzie River on the Arctic coast. The leader of the party, biologist Charles E. Gillham, last year investigated waterfowl conditions north to Lake Athabaska. He will remain in the far north until the waterfowl start their trek to the south at the time of the freezeup, when he will return by air through Yukon Territory and Alaska. Naturally his report on conditions in the north is not yet available, but writing from Fort Resolution, N. W. T., under date of July 14 he stated that "there may be a slight improvement in bird abundance" in the Athabaska-Peace country and that in his opinion ducks were much more numerous in the Prairie Provinces than a year ago. In the Great Slave Lake region waterfowl were not so abundant as last year, which he interprets as meaning that larger numbers remained farther south because



The Athabaska River delta region of Canada is an excellent waterfowl nesting region and the picture at the left shows a fine breeding area at Egg Lake.

Typical of good waterfowl habitat is the picture at the right, of Jackfish Lake in the upper Athabaska delta. (Below). Lake Magloire in the Peace River district of Alberta. Thousands of acres of ideal nesting grounds that have not been touched by drought and probably will never be touched by the dredge.



Photos by L. J. Goldman.

of improved conditions there. As this report is being typed, a radio report dated August 28 is received from Mr. Gillham, in which he states, "Far North duck crop normal."

The fifth Biological Survey party started its

work in the Maritime Provinces of Nova Scotia and New Brunswick; made a brief reconnaissance through the Gaspé Peninsula of Quebec, and then crossed over to Newfoundland. The information then obtained was most encourag-



(Top). Canada geese encounter a belated snowstorm at the Inglewood Bird Sanctuary near Calgary. (Middle). A deceptive haven—famous Johnston Lake, Saskatchewan, nearly dry. The white expanse in the distance is alkali. (Below). A typical prairie pot-hole. Thousands of such small water areas provide abundant nesting facilities for all species of waterfowl. (Photos by W. H. Ransom, C. M. Aldous, L. J. Goldman).

ing, particularly since the northeastern or coast-wise flight of black ducks has not made a good showing during the last few years. In the Tan-tramar Marshes, near Amherst, Nova Scotia, a slight increase was noted in the nesting birds. This area of about 80 square miles is reputed to be one of the best nesting grounds in the Maritimes for the black duck. Noticeable increase of this species also was observed in the Annapolis Valley marshes, Grand Pré marshes, and in the Gaspereau and Cornwallis Valleys. A similar situation was found in Newfoundland, which apparently is producing a fairly good crop of Canada geese and black ducks.

Summing up their report, the members of this party concluded that there was a slight increase in nesting black ducks, that more birds had returned in the spring migration, and that excepting eelgrass, most natural waterfowl food plants were plentiful. The eelgrass, by the way, continues to be in bad condition, although some regrowth has been reported. It appears to be better in Newfoundland waters than anywhere along the coast of the mainland.

Breeding Grounds in the United States

Aside from areas in Federal refuges, the Great Plains region of the United States produced very few waterfowl during the 1936 season. Large parts of old nesting areas that dried out in 1934 continued in that condition, however, so the losses were not nearly so heavy as they might have been. Moreover, thousands of acres of new refuge lands are now under management, and these proved to be a waterfowl paradise. The gains made on the new refuges in Nebraska and in the Dakotas undoubtedly more than offset some of the losses elsewhere.

Working under the direction of Survey and State officials, the personnel of several Civilian Conservation Corps camps was organized for waterfowl rescue operations in sections where shallow prairie marshes were drying up. Altogether, more than 5,000 ducklings with their mothers were thus collected and moved to the well-watered refuges.

A Word of Caution

As will be readily deduced from the foregoing account, the Biological Survey expects for the fall migration of 1936 an increase over 1935 for most species. Some recent reports from Canadian officials are not, however, so sanguine,

and the Canadian Government has instituted drastic restrictions on shooting privileges for the coming season that closely approximate those approved by the President for the hunters of the United States. The closest cooperation, however, exists between the Bureau of Biological Survey and the Canadian National Parks Branch, and sportsmen and naturalists may rest assured that there is no controversy between the wildlife agencies of the two governments. Waterfowl reports from Canadian naturalists, the Royal Canadian Mounted Police, and other observers are sent to the Survey by the Commissioner of Canadian National Parks, while copies of the reports of its own field parties are sent by the Bureau to both Dominion and Provincial game departments.

Conclusion

As a result of improved conditions on the breeding grounds in 1935, coupled with heavy restrictions in shooting privileges for that season, an increased number of ducks and geese was saved for the 1936 nesting season. Though the expected increase was somewhat lessened by starvation and freezing during the severe winter of 1935-36, the reports of five field parties that operated during the summer of 1936 on the Canadian breeding grounds indicate a definite increase there in the numbers of the birds. Throughout most of the important nesting regions, the hatch was good, with a high percentage of the young brought to maturity. Exceptions are the canvasback and the redhead.

Severe drought conditions in parts of the breeding range did unquestionable damage and probably resulted in the loss of part of the crop of ducklings, though there is no evidence that this was heavy in any section. Such losses as may have occurred locally were probably more than offset by gains elsewhere.

Nevertheless, enormous areas in the north still support but a fraction of their potential capacity in ducks and geese. Complete recovery could be speeded up, of course, by complete suspension of shooting privileges for a year or for a term of years. If, however, a slow but steady improvement can be accomplished along with opportunities for the real sportsmen of the country to enjoy their favorite recreation each year, even though it involves more hunting and less shooting, the cause of conservation will be definitely served.

What the Park Is Doing for Education

Movies and Lantern Slides and Docent Service Make Zoology
Very Real to Thousands of School Children

CLAUDE W. LEISTER

ONE of the primary aims of the New York Zoological Society is to promote the study of zoology. The operation of the Zoological Park with its representative collection of the world's animals has in itself furnished a great incentive for millions of visitors to learn more about the different species they find on exhibition. The publications of the Society are widely distributed and the resulting dissemination of knowledge concerning animal life has been notably worth while.

In 1929 a definite effort was instituted to place the Zoological Park on a firmer basis as an educational institution. This was brought about through the formation of the Department of Educational Activities, designed to centralize the efforts of the staff in educational matters and to bring about a more closely organized relationship with the public school system of New York City.

With the effective organization of this department it was at once possible for the schools of the city to take full advantage of the unique opportunities offered by the Zoological Park. Formerly, any work done with visiting school groups had to be arranged at the convenience of the curators of the various departments and more frequently than not they were able to give such aid only at the expense of neglecting their regular duties. Now the new department was in a position to give full-time assistance to all groups visiting the Park collections.

Following the consideration of several plans for effective action, it was apparent that a modified form of docent service would secure the greatest amount of satisfaction for all concerned. Groups of very small children are largely interested in the picnic and entertainment features of a visit to the zoo. A skilled docent, or teaching guide, is not really necessary for such groups and the teacher in charge can give satisfactory service for the occasion,

especially since she is furnished at the gate with a mimeographed bulletin which calls attention to new and rarely exhibited animals, special exhibits and their location. For groups of older children, especially those of Junior High School age, a docent is invaluable. Knowing just what animal types and forms are available he can quickly bring them to the attention of the class. Since these animals are alive and active a number of traits and habits can be observed at first hand, creating a vivid, lasting impression to be carried back to the classroom.

The answers to questions such as "What does a giraffe eat?" "Is that snake poisonous?" "What kind of a bird is that?" can usually be given by a demonstration. An effort is made to satisfy the demands and interests of each class with the result that these trips are not stereotyped but vary considerably. Some school groups have been studying reptiles, others mammals, still others birds. Trips are so arranged that a considerable amount of information can be gained concerning these various animal groups, information that is not likely to be gained in the classroom nor during the course of an ordinary visit to the Zoological Park. The "behind the scenes" feature of these trips affords the student the opportunity of seeing for himself, close at hand, many different forms of the world's animals along with the necessary devices and routine for maintaining them in captivity.

During the past two years groups of older students have been allowed to visit the Hospital. Here classes can usually see several animals undergoing treatment as well as a number of pathological specimens. The average high school student is unfamiliar with most of the equipment and necessary apparatus. Opportunities to visit an animal hospital are few and far between, with the result that without advertising this trip has become almost too popu-

7A-8B A Day at the Zoo

Sketches from Life

At the Zoo

I went to the zoo one day,
That was a spring day in May,
I saw the animals that like to play,
And heard the birds that were chirping away.
Selma Rich- 283

MY VISIT TO THE BRONX PARK

At the Zoo
I went to the zoo one day,
That was a spring day in May,
I saw the animals that like to play,
And heard the birds that were chirping away.
Selma Rich- 283

THE LION

At the Zoo
I went to the zoo one day,
That was a spring day in May,
I saw the animals that like to play,
And heard the birds that were chirping away.
Selma Rich- 283

OUR ZOO

At the Zoo
I went to the zoo one day,
That was a spring day in May,
I saw the animals that like to play,
And heard the birds that were chirping away.
Selma Rich- 283

THE LION

At the Zoo
I went to the zoo one day,
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At the Zoo
I went to the zoo one day,
That was a spring day in May,
I saw the animals that like to play,
And heard the birds that were chirping away.
Selma Rich- 283

Children in Public School 34 drew these pictures in the Zoological Park and wrote the text about animals, to illustrate "The Van Nest," the school's 1935 yearbook.



Visits to the Hospital, with occasional opportunities to play with some of the animals kept there for study, is always one of the high spots of a school's tour of the Zoological Park. Here a group is getting a lesson in chimpanzee table manners.

lar from our standpoint. Because of the nature of our hospital work definite visiting hours can not be established and we have received so many requests for this trip that all of them could not be granted.

Records show that 735 organized groups of children entered our gates during 1935 and while not all were school groups it is easily recognized that a tremendous opportunity exists for reaching these children in an educational way. To date the city of New York has not shared in our efforts to embrace this opportunity. For years a budget appropriation has been regularly disallowed for this work and all expenses incurred have therefore been borne by the Society. It is hoped that the importance of this work will soon be recognized by proper financial support from the city.

It is not generally known that the Zoological Society possesses a collection of animal photographs, perhaps the most extensive in the world, now numbering some 15,000 negatives. While these photographs have had a wide use in book

and newspaper illustration, they were not available for general school use. Now the most desirable and effective of these photographs for teaching purposes have been made available in lantern slides and sets can be borrowed by any school in New York City. The demand for their use has increased steadily and last year eighty schools appeared on our borrower's list. Good animal pictures for classroom illustrations are difficult to obtain and the Society collection, noted for its photographic excellence, is now able to satisfy a definite demand for such material. It is difficult to appreciate fully the educational value of this collection.

Motion pictures of animal life of course exert a tremendous influence in natural history education. As might be expected, the Zoological Park furnishes numerous opportunities to obtain valuable movies of many rare and little-known forms of animal life. Animal actors, however, are exceedingly temperamental before the camera and the photographer's patience and ingenuity are taxed to the utmost in obtaining



The picnic grounds of the Zoological Park, on the east side of Boston Post Road, are extremely popular in summertime and families and neighborhood groups make constant use of the facilities for "a day in the country in New York City."



Every piece of apparatus in the Hospital comes in for interested examination when school groups visit the Park.

suitable pictures. It follows that the production of an animal movie, even with captive animals, is an expensive operation and suitable films are a long time in the making.

Some years ago Dr. Raymond L. Ditmars produced his "Living Natural History" series of 35 mm. movies, utilizing to a large extent the animal collections of the Zoological Park. That series contains the best and most comprehensive pictures of animal life that are available today.

Because of the precautions and expense involved in exhibiting standard (35 mm.) movies they have never been particularly satisfactory for school use. During the past few years they practically ceased to exist in New York City schools, being replaced almost entirely by 16 mm. films. This change must be considered inevitable when we consider the tremendous improvements that have been made in 16 mm. equipment. It is possible to project better pictures today, under school conditions, with 16 mm. apparatus than was possible a few years ago with 35 mm. film.

While very few schools now make use of the larger films, the demand for 16 mm. subjects is far in advance of the available supply. This change was brought about so rapidly as to

find us with an excellent collection of 35 mm. school movies to supply a rapidly disappearing demand, and with no 16 mm. subjects whatsoever to satisfy a sky-rocketing demand for that width.

We have been gradually rectifying this condition. Two full length (400 ft.) 16 mm. subjects are now available and two more are in production, although they will not be ready for use this fall. It is only a matter of time until we can offer an adequate series of 16 mm. films dealing with animal life.

These new services are greatly appreciated by schools throughout the city and many letters are received from teachers who enthusiastically praise our efforts in their behalf. The demand for all our services, especially for slides and films, has increased regularly and steadily from year to year and last year teachers reported that they were shown to 75,000 school children.

The animal collections of the Zoological Park furnish desirable models for artists and sculptors and such use of our animals has always been encouraged. Public school students like-

wise find that visits to the Park furnish inspiration for numerous school projects. Many of these are done entirely within the classroom. Other, more ambitious, undertakings sometimes entail several visits to the Park and resulting requests for photographs, historical information and other materials have been supplied by this department.

The education of the general public in natural history is a slow process but the average visitor to the Zoological Park today has a much more sympathetic feeling toward animal life than was the case a generation ago. His knowledge concerning animals and their ways is usually well founded but there is room for improvement. Visitors to the Reptile House still ask to be shown the hoop snakes. They have even come in search of "fire-spitting dragons." Our native gray squirrels are supposed to migrate each fall never to return and annually we are obliged to purchase a new supply. When vampire bats were first exhibited three years ago a number of misguided individuals expected to find them in the bird house.



Playtime in the Park.

When the Seas Pay Tribute

It Is Sometimes Easy to Collect, But Transportation of Fishes Almost Always Means Difficulty

C. W. COATES

New York Aquarium

IN writings that have come down to us from ancient Rome it is quite evident that the Romans were particularly keen about oysters as an article of diet, and it is pretty strongly, if somewhat obliquely, attested that they had found methods of transporting these succulent bivalves considerable distances.

Many of their writers discuss the merits of oysters from different localities and there was considerable difference of opinion as to which were best. Pliny talks about them at considerable length; Mucianus considered the British oysters from the beds at Rutupiae, now Richborough, near Whitstable, the sweetest; Juvenal mentions them, and Dalecampius considered the same kind nutritious.

Present day authorities suggest that the oysters were moved in blocks of snow, being packed in a manner similar to our own use of ice. This might indicate the origin of the use of oysters only in those months containing the letter "R," for it would be impossible for the ancient shippers to procure snow in other months without enormous trouble.

Be that as it may there are still problems of considerable size to be solved in the successful transportation of aquatic animals, especially so in the moving of food animals, although numerous attempts to transship fishes from the coasts to inland towns are made in many countries. In some of the Scandinavian countries motor trucks with built-in circulatory systems for sea water are in use and have been proposed for use here, but little has been accomplished to date. However, we in the Aquarium are not particularly concerned with the moving of food creatures in bulk, except as we are called upon for assistance. Our problems are to procure a few representative aquatic creatures from every part of the globe in as good health and spirits as possible. In this we are comparatively successful, but the shifts to which our collectors

and transporters are put are not easily imagined. It will not do to put a fish in a tank of water and expect it to survive safely a long steamer or train ride. The commercial shipment of small living fishes is now almost a major industry, for there are tens of thousands of fishes suitable for pets in transit every day. Some of these may be in the express cars of fast trains and many more in specially prepared rooms on ships.

The proper type of container was something that had to be worked out through the years by the trial-and-error method. Many kinds and shapes of container were tried and discarded before arriving at the present standard shipping can for small aquatic creatures. This can, standard throughout the fish world for small fishes, is circular in shape, about twenty inches across and five high, with shoulders sloping at an angle of some thirty degrees to a mouth about one foot wide. The circular shape prevents fishes from swimming too abruptly against the sides and so damaging themselves, as well as stopping a good deal of train or boat sway. The sloping shoulders throw back the water as it splashes and rid it of accumulated gases. These cans will safely carry as many as three hundred tiny fishes several thousand miles without attention, although the usual shipment would not be more than perhaps fifty, or a hundred for short jumps.

On the ocean liners, however, which regularly bring thousands of these fishes, a special room is taken by the shipper and rigged up with miles, actually, of small rubber air hose, air releasers, air compressors—to supply air to otherwise overcrowded cans—thermostatic controls for heat, and much wooden shelving. On the shelves are stacked hundreds of shipping cans and a runner is constantly in attendance. The runner, although no part of the ship's crew, lives entirely on the ship and spends his whole

time attending to his charges. There are at least six fast Atlantic liners so equipped, some others which run between New York and South American ports, and several which sail between European ports and the East Indies. On the East Indian runs, which are much longer than the Atlantic trips, it has been found necessary to establish what may be termed "fish hospitals" in the various ports of call, so that fishes which are distressed by travel may be put ashore to rest awhile before being picked up by the next steamer. These "hospitals" are run by the commercial houses, of course.

The reason for the use of "fish hospitals" is that while a few people maintain that fishes do not suffer from *mal de mer*, most fish runners have found that they suffer a seasickness which may be fatal, which *will* be fatal to all in the container, in fact, if just one or two of them become so distressed as to vomit, unless they can be moved to new water, and new suitable water is not easily available. Some species are so prone to these illnesses that they cannot stay on the steamer for very long—a few days or a week or so being their limit. Then they must be taken off, rested and reconditioned with suitable waters and foods, and another leg of the journey attempted. Besides this, many fishes will not eat all the foods offered to them. For one reason or another the ship may run out of the suitable kind and at the "hospitals" the runners are able to procure just the proper food or a close substitute, without the delay which would follow if there were no one immediately available to provide it.

Besides steamers on water and trains and cars on land, many fishes are transported by air. In Europe there are constant express shipments by the regular lines and just recently a small commercial collection of fishes was sent from Hamburg to Frankfort-on-Main by plane, from Frankfort to Lakehurst, New Jersey, by the Zeppelin *Hindenburg*, thence to Newark by fast car, and from there to Chicago by plane again. Unfortunately, only one fish out of the shipment of six survived the *Hindenburg* ride, but though no care was needed for this short trip—short in time—we suspect that it was lack of experience on the part of the crew that caused such a high percentage of loss. When the can was taken off the airship the water was quite cool for the tropical fish and the chill-

ing no doubt occurred when the express freight was being brought from the storage space to the gangway, to save delay in unloading. These particular fish travelled many miles before the survivor reached its destination in the John G. Shedd Aquarium in Chicago. They were taken in Peru, transported by water to France, thence by rail to Hamburg and from there through their air adventures to Chicago.

We sometimes receive unexpected shipments of fishes from what may be considered unusual sources. On one occasion the Standard Oil Company of New Jersey called us by phone that it had three small fish for us on one of its tankers at the oildock in Communipaw. The fish, the oil company said, were in a small box, and would we please send for them? Our usual experience is that fishermen and fish people generally enlarge considerably on the size of their fishes and we were totally unprepared to find that the "small fish" on the tanker were electric eels more than seven feet long and the "small box" an affair that was nine feet in length, six wide and three deep and made of two inch planks. It was, of course, impossible for us to move such a box and while we were considering what we would need to carry the eels to New York, word was received that the ship was to clear almost immediately for another port. It was too late to return to the Aquarium for apparatus so we looked about for something on the spot, finally acquiring, through the courtesy of the company, a new barrel. We still had to transfer the eels—no small task—but eventually we steered them into burlap bags, taking great care that one part of the bag was dry so that we would not be paralyzed by the electricity. However, in the struggles of one of the eels in the bag, a man handling the creature accidentally touched a wet part of the burlap, was stunned by the electricity and all but crushed to death between the ship and the pier when he fell. We saved the eel.

Still, deriving as we do many of our exhibition creatures from such sources—casual shipments from our friends and commercial stock—by far the vast majority must be brought in by other means. For a reason we have not fully understood, the most successful of the non-professional fish carriers, as far as we are concerned, are ships' engineers and radio men. Generally, deck officers and other members of ships' companies either have not the time, the patience,

or the desire to bother with fishes, but some of our most valued exhibits have been brought to us by technical men aboard ship who hope for no other reward than to move safely these fishes from there to here. They go to extraordinary lengths in their efforts to deliver the fishes alive, designing and making all sorts of elaborate apparatus for moving air or water through the tanks, commandeering empty cabins and bathrooms for the storing of the fishes, staying for hours, off watch, with their charges, purchasing books to help them decide which of the available fishes they might best carry, and generally being indulged, as long as their self-imposed duty does not impair efficiency, by their immediate superiors and the owners of the ships. We are continually at a loss as to the reason these men undertake their onerous tasks, and their distress when they lose specimens is sometimes more than our own when we hear of it.

While we occasionally receive fishes from men who stop at New York once in many years, many of our best fishes—apart from those taken

by our own collectors who have their own troubles—are brought to us by these volunteer collectors. Some of the headaches suffered by these fishermen for living fishes were recently recounted by Mr. J. F. W. Emde, whose name is familiar to readers of the *Bulletin*. Mr. Emde is an engineer on one of the Holland America Line ships, and for the last four years has contrived to bring us something nearly every time he came to New York. Sometimes the fishes he carried were in exchange for fishes we sent in his care to Rotterdam Aquarium and at other times they represented his own efforts as a fisherman in whatever water was available at the other ports of his voyage.

During a recent series of cruises to Bermuda Mr. Emde had an afternoon or so free on each trip—afternoons which he invariably spent in catching fishes. On the first trip, after walking two or three miles, a suitable spot for fishing was found and a number of fishes taken. He put them in a transporting can of his own devising, in which aeration could be effected by



Photo by Amazonica, Inc.

In such tanks as these at Belim, Para, newly caught tropical fishes are kept for conditioning before shipping. These outdoor tanks are covered with wire screens and many lily pads, and the trellis over them provides an added amount of shade.



Photo by Amazonica, Inc.

Tropical fishes must be accustomed to smaller quarters and stiller waters than their native streams or breeding pools before they can be shipped in safety, and thus they are kept for a time in this large indoor battery of conditioning tanks at Belim.

means of a rubber ball and a length of tubing. When the can was full, with more than one hundred fishes, he and an assistant started to carry the heavy load to the ship. They were delighted when a passing carriage offered to take the can and deliver it for them. When Mr. Emde arrived at the steamer he found it awaiting him, but someone had placed the can in a hot cabin and left it there. All the fishes were dead. He had not time to make another collection.

On the second cruise, Mr. Emde decided against accepting lifts for his fishes and procured a pair of wheels from a baby carriage to make a little cart, for two cans this time, to make up for the losses last trip. Using a small seine he soon filled one can and left it with one of his own men to work the rubber ball and tube arrangement while he went elsewhere to fish for other creatures. After an unfruitful hour or two he returned to his first can and found all the fishes dead again—this time because the attendant had fallen asleep in the hot sun. However, not unduly discouraged, they

emptied the can and started again and made a small collection of desirable aquarium specimens. On their return to the ship, wheeling the small cart with the cans, they encountered a native who had for sale some “calves’ livers” he had found in the sea. Seeing they were alive, Mr. Emde procured them, and thus our first sea pigeons arrived in the Aquarium. The fact that these were the first to be exhibited in New York satisfied the amateur collector, apparently, more than if he had found a dozen pearl oysters in his seine.

On the third trip Mr. Emde and his helpers secured a nice collection of fishes and safely established them aboard ship. Having still an hour or two before his ship duties commenced, he went off to look at the Bermuda Aquarium and returned to be met by a stewardess in tears. She had been cleaning in the bathroom in which the fishes were accommodated and had paused to watch them. Inadvertently she had dropped into the bath a can of chloride, making short work of the creatures. Fortunately there was still time to make another collection, both fishes



In racks of cans such as these tropical fishes are carried by steamer from South America to New York. The cans are insulated against temperature changes by layers of felt and strong paper, and air lines are connected with each.

and sea pigeons being taken and placed in the bathtub, with a locked door this time. However, the sea pigeons were the undoing of this shipment, for one of them got its head wedged in one overflow and another apparently went to sleep on the other overflow, with the consequence that the bath filled and washed out all the fishes, the sole survivor of the catastrophe being one sea cucumber.

Another more or less permanent collector for us is Mr. A. M. Vida, whose name should also be familiar to *Bulletin* readers. He is a radio operator on the American-South African Line. The troubles of this collector are of a different hue. Not stopping in any one port, where fishes may be taken, long enough to make a collection himself, Mr. Vida has built up a most elaborate system of exchanges with individuals and institutions along his course. The first stop on his run is St. Helena, from where we would much like to have fishes. However, the available fishes—exchanged for old clothes, hats, shoes, etc.—are all marine and the steamer spends a good deal of time after leaving St.

Helena in waters which are predominantly fresh. Consequently no necessary changes of water may be made. The fishes, highly desirable to the public institutions of the Union of South Africa, are taken by them in exchange for other fishes from their own waters, which are, however, not put on board until the steamer makes its call on the way home. The ship does not stop at St. Helena on the way back and only once were we able to procure any fishes from there. However, such fishes as the zebra fish, which are exchanged for them, are unavailable to us through any other channels, so we are perfectly satisfied with this swap.

Farther up the coast, where the ship puts in to muddy estuaries such as at the port of Beira, the strange lungfish are available in exchange for sticks of chewing gum, cigarettes, whiskey and other desirable articles of barter. These topsy-turvy fish, which travel better in a block of dry mud than in water and only breathe atmospheric air, would seem a fairly safe bet for transportation, but not more than four or five arrive alive each year, others managing to jump

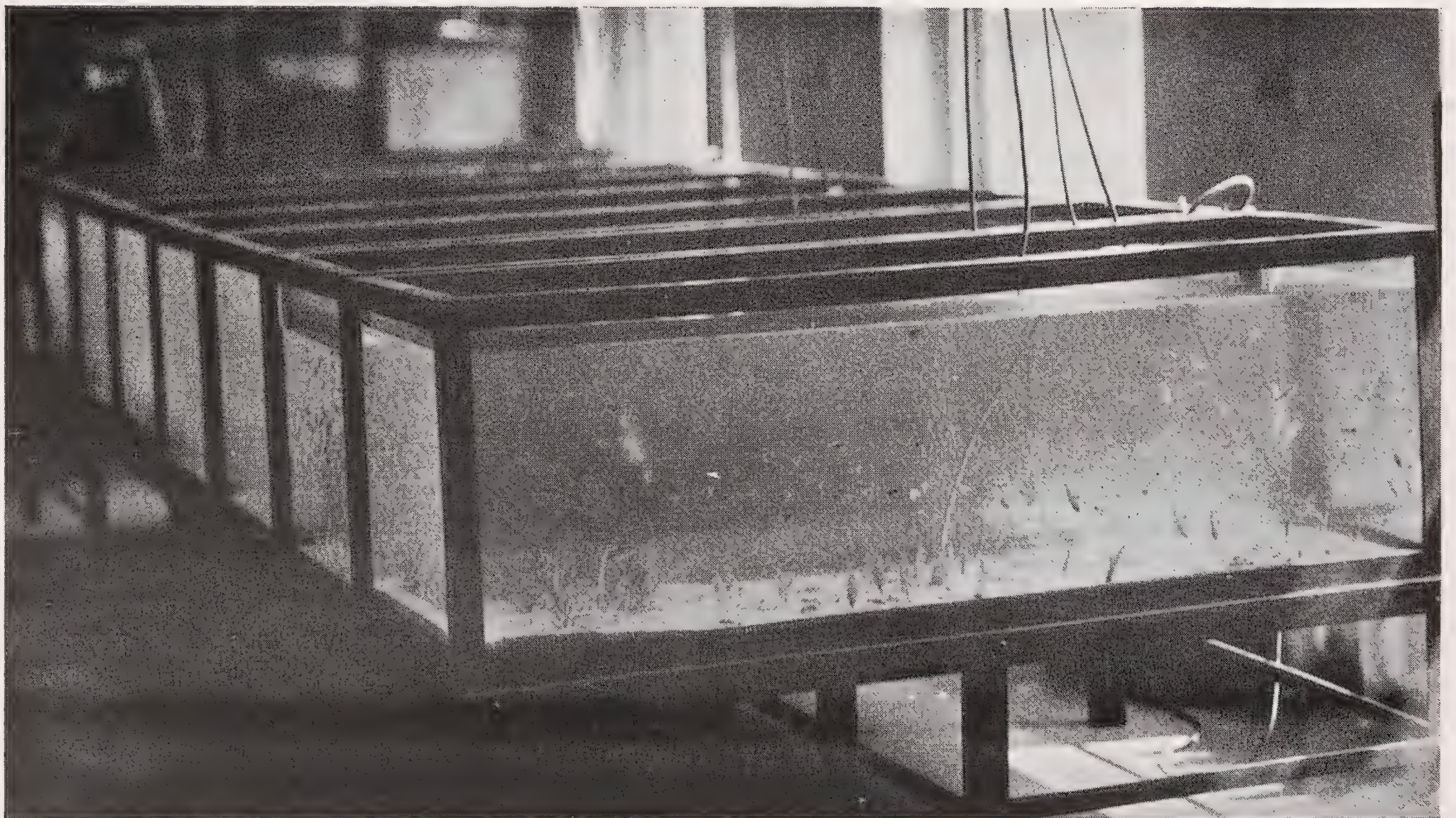
out of the tanks and dry up in the radio room in spite of the most careful covering, or dying for unknown reasons. We tried at first to persuade Mr. Vida to bring us back some of the *Periophthalmus* he sees hopping on the mud wherever he stops, but after he had been bogged down to his shoulders in mud, and almost had his head eaten off by mosquitos once or twice, he decided that such critters had better be caught by somebody else—a decision in which we fully concurred.

One of the most important stages of the journey from their native waters to the tanks of the Aquarium is the short leg from the ship to the Battery. Sometimes heat is turned off in certain steamers when the ship leaves Quarantine, sometimes the transporter is so busy with the business of the ship that he cannot possibly attend to the fishes, no matter what happens, sometimes fumigation must be done and several choice specimens which have safely negotiated the long trip from Africa or India or South America, have died between Quarantine and the dock. For this reason it is imperative that

we move the fishes off the ship as soon as possible after she ties up, an obligation in which we are unfailingly assisted by the U. S. Customs Service and its inspectors at the piers who cooperate with us to the utmost of their ability, issuing in advance, on presentation of proper documents and credentials, special bonds because of the perishable nature of the shipments.

In spite of these various difficulties involved in the actual transportation of the fishes and outlined here merely as representative in part of the troubles of the unofficial ambassadors of the Aquarium, our collections come from an immense area of the world's waters, our tropical sections—both marine and fresh—showing fishes from a complete equatorial band about the earth.

So in spite of all modern facilities, built-in heating and cooling arrangements, compressed air, flowing water, trains and ships, there still remain other things to think about in the transportation of living fishes and the more we know the more we marvel at the ancient Romans and their oysters.



A resting place after the voyage—receiving tanks for “tropicals” in New York.



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NOTES FROM THE ZOOLOGICAL PARK AND THE AQUARIUM

New Exhibits at the Aquarium

The arrival of seven ships in New York in the course of one week with cargoes for the Aquarium supplied a considerable number of new and interesting exhibits.

One of the most curiously specialized fishes in the world is the South African mudspringer (*Periophthalmus koelreuteri*), which spends a good part of its time on land instead of in the water. Mudspringers have been exhibited from time to time at the Aquarium, but seldom as effectively as at present when six specimens occupy a tank on the second floor. Their habitat in the tank is rather un-fishlike—a bed of moist sand, a rock, and a tiny pool of water in a depression in the sand. It is, in fact, so different from the habitat given the other fishes that several persons have called the attention of Aquarium attendants to the tank, thinking that it had sprung a leak and that the fishes would die.

The mudspringer is closely related to the gobies and in some of its habitat requirements is also akin to them, for it may be kept in fresh water. However, it prefers brackish.

In the Old World—it is not found anywhere in the New World—the mudspringer can be found at the mouths of warm rivers from West Africa to the East Indies and northern Australia.

At least three-quarters of the fish's life is spent on land. At the Aquarium specimens have often been watched hopping around on mud bars, catching mosquitoes, for as long as half an hour.

Quite frequently when the fish is disturbed while on land, it will dive for a hole made by crabs instead of taking refuge in the water.

The diet of mudspringers is normally living food,

such as garden worms, small crustaceans, insects such as flies and mosquitoes—which they catch on the wing, by jumping—and similar foods. However, the Aquarium has managed to keep them going for a year or two, experimentally, on chopped fresh clam. Tubifex worms are a delicacy that they appreciate.

The average mudspringer is about six or eight inches long.

Among other recent acquisitions of the Aquarium are four lobe-fins, or reed fish (*Calamoichthys calabaricus*) and four razor fishes (*Xenomystis nigri*), sent as a gift of the London Aquarium; a Congo eel (sometimes known as a "legless lizard," although it is neither a lizard nor legless), a giant Japanese salamander (*Megalobatrachus maximus*), three black-foot penguins, a baby lungfish about two and a half inches long, a giant grouper of some 300 pounds, and approximately 750 specimens of marine fishes and invertebrates from Key West.

The giant grouper is the largest fish in the Aquarium at present, although at various times in the past other groupers almost equally large have been exhibited.

A Correction

On Page 161 of the July-August, 1936, *Bulletin* it was stated in a note entitled "Man-eater" that the shark under discussion was taken on a hook and line. Actually, the shark was harpooned.

A Baby Lechwe Is Born

Lechwe waterbucks (*Kobus lechwe*) are rare in captivity and the Zoological Park has the only pair in the United States. The birth of a young lechwe on the morning of August 27 was, consequently, an event of interest and importance—which was not lessened by the attempts made by the male to gore the youngster a few minutes after birth.

The baby was born about 11 A.M. in a large corral outside the Antelope House. The male was allowed to remain in the corral and no danger from that source was anticipated by Keeper George Kress, as he seemed quite indifferent to the arrival of his daughter and, indeed, remained at the far end of the grassy range.

An instinct to lick the baby and stay close to it struggled with a natural timidity in the mother and for half an hour after the birth of her first baby she trotted nervously around the corral, stopping only at intervals to attend to the baby. Still the male remained at a distance and Keeper Kress, with other work to do, left the three animals in the corral and went inside the building.

A few minutes later an instinct that develops in good animal keepers prompted him to roll back a door and glance down the length of the corral toward the baby. What he saw sent him running through the bongo's stall and down the adjacent range toward the baby.

Apparently a few minutes after the keeper went inside the male lechwe started an investigation of the newcomer, and, not liking the intrusion, turned his sharp horns toward it. When Keeper Kress opened the door, the male was standing in front of the baby, head down and forward-curved horns pointing earthward, trying to stab the youngster. The baby was bawling in



Photo courtesy New York Sun.

Drama was in the making as this photograph was taken. The baby lechwe waterbuck is receiving the somewhat surprised care of its mother, while the male looks on from a distance. A few minutes later the male tried to stab the baby with his horns.

a low, weak voice, struggling to get to its feet while the horns time after time struck the ground on either side of its body.

A few yards away the mother stood and gazed indifferently toward another corral.

The keeper rapped on an iron door as he sped out of the building and for a few moments the male halted his attack and stood staring toward the noise. The interruption gave the keeper time to seize an iron rod for protection and open the gates that stood between him and the end of the corral directly opposite the baby.

As he disappeared into the bongo's corral, a white-faced girl raced into the Antelope House calling for the keeper. She had been watching the baby when the male appeared and attacked it, and while her mother rattled a stick against the fence to frighten the male, the girl had run for help.

Keeper Kress climbed the fence between the lechwe's corral and the runway and the moment he appeared the male galloped away. Keeping an eye on him, and the iron rod in readiness for defence, the Keeper gathered the baby in his arms and climbed back over the fence.

The baby was unhurt—thanks to the quick intervention and the bad aim of the male's horns. Later in the morning the baby was segregated in an empty stall and corral with its mother and during the afternoon it gained strength enough

to walk with awkward, wabbling steps, and to nurse.

Although it still depends upon nursing as its chief sustenance, the baby started nibbling grass, grain and hay within two weeks, and at present seems to be healthy and strong.

In Keeper Kress's experience, vicious attacks on baby antelopes by the males are not unknown. A few years ago a nyulghai was born in the Park and before it was rescued it took a severe drubbing from its father. The male's rushes and jabs drove the baby all the way under the range fence—a fact which almost certainly saved its life.

The parents of the baby lechwe came to the Zoological Park on May 13, 1935, from their native south Africa. In color a pale brown, except for the underparts and rings around the eyes, which are whitish, the male lechwe is equipped with some of the most formidable horns on any antelope. Although they are said to be seldom longer than 24 inches, they are needle-pointed and curve outward.

In his "A Hunter's Wanderings in Africa," Frederick Courteney Selous commented upon the lechwe's gait in the swamp country that is its habitat:

"When they first make up their minds to run, they stretch out their noses, the males laying their horns flat along their sides, and trot; but on being pressed they break into a springing



Courtesy Wide World Photos

Here are the young pronghorns on their arrival at Newark Airport, snugly encased in their traveling bags and not at all alarmed by their journey. At the right are Mr. Charles J. Belden and his daughter, Mrs. Lewis R. Stewart of New York.

gallop, now and then bounding high into the air. Even when in water up to their necks they do not swim, but get along by a succession of bounds, making a tremendous splashing. Of course, when the water becomes too deep for them to bottom they are forced to swim, which they do well and strongly, though not so fast as the natives can paddle; and when the country is flooded, great numbers are driven into deep water and speared."

Pronghorns by Air

The delivery of animals to zoological parks by airplane is somewhat of a novelty—but a novelty with strong elements of practicability. The Zoological Park received six young pronghorn antelopes on Tuesday, August 18, by airplane delivery from the Pitchfork Ranch at Pitchfork, Wyoming, some sixty hours after they left their range.

The pronghorns were shipped by Mr. Charles J. Belden, owner of the ranch, as part of an initial cargo of twenty-three. Others were delivered to zoological parks en route to New York and of the sixteen that reached New York, ten were turned over to a dealer who immediately put two aboard the dirigible *Hindenburg* for shipment to a German zoological collection.

The young pronghorns, born on the Belden ranch in May, were in perfect condition when they arrived at Newark Airport. They had traveled in the passenger and baggage space of Mr. Belden's plane, snugly encased in burlap bags which prevented movement of their legs but enabled them to eat and drink freely. They displayed no signs of nervousness, despite the unaccustomed noise and motion.

During their first week in the Park they were fed three times a day from bottles, taking with relish a liquid in which milk was the main ingredient. Later as they began to eat a little grass and oats and oatmeal, their bottle rations were cut down to two feedings a day.

At the age of about four and a half months their horns are still not externally apparent, but can be felt as slight bumps on their foreheads.

Mr. Belden accompanied his pronghorns and inspected them at the Park after they were installed in a large corral. He offered to write for the *Bulletin* an account of how young pronghorns are captured and tamed on his ranch, and if the exigencies of cattle and further shipments of pronghorns permit, his article will appear in the November-December number of this magazine.



At first dinner time came three times a day after the pronghorns were delivered to the Park, but now they are learning to forage for themselves in their corral.

Dr. Ditmars in Trinidad

Dr. Ditmars, the Curator of Mammals and Reptiles, sailed for Trinidad on September 10 with members of his family for his annual vacation. He hopes to bring back, for exhibition at the Zoological Park, specimens of the curious frog, *Pseudis paradoxus*, which is found in certain ponds on the island. The so-called Paradox Frog is extraordinarily large in its tadpole stage, subsequently shrinking to very small proportions.

PUBLICATIONS OF INTEREST

THE MIGRATION OF NORTH AMERICAN BIRDS. By Frederick C. Lincoln. Circular No. 363, United States Department of Agriculture, Washington, D. C. 72 pages, illustrated by maps and photographs. Superintendent of Documents. 10 cents.

The father of the study of bird migration in America, Prof. Wells W. Cooke, were he alive today, would enjoy a sense of extreme gratification at the outcome of his life-work as shown in "The Migration of North American Birds," by Frederick C. Lincoln. Professor Cooke's first publication for the Department of Agriculture, "The Report on Bird Migration in the Mississippi Valley," was printed in 1888, and his last report, "The Distribution of North American

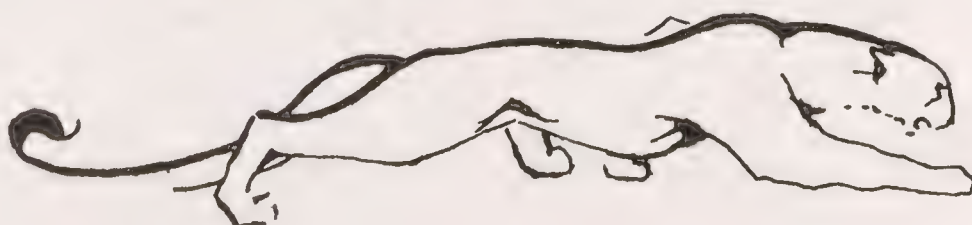
Gulls and their Allies," in 1915. Since then, general interest aroused by the results of his work never abated, but instead increased by leaps and bounds, to a point where thousands of persons are now involved in gathering migration data to one so occupied in his day.

The almost universal application of the practice of bird banding as an aid to the study of migration has been mainly responsible for thousands of cooperators during the last decades, and the vast amount of information thus made available to Mr. Lincoln has been used to good advantage in writing the present pamphlet. Evidence showing the seasonal range of individual birds, especially east and west movements, is particularly interesting since little was known of that phase of migration in Cooke's day.

The flyways or migration routes used by different species are well portrayed in numerous figures illustrating the text. There is a good bibliography of papers on bird migration.

Mr. Lincoln has given us a good job in this survey of the present status of the study of bird migration in America. It is not for the ornithologist alone, since there is much of interest for the general reader.

In spite of our vast accumulation of knowledge concerning the present-day movements of birds, a satisfactory explanation of the causes of bird migration is still denied us. This great mystery, so obscured by time and change, may never be revealed.—C. W. L.



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Clark and Fritts, New York, Printers.



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NEW YORK ZOOLOGICAL SOCIETY



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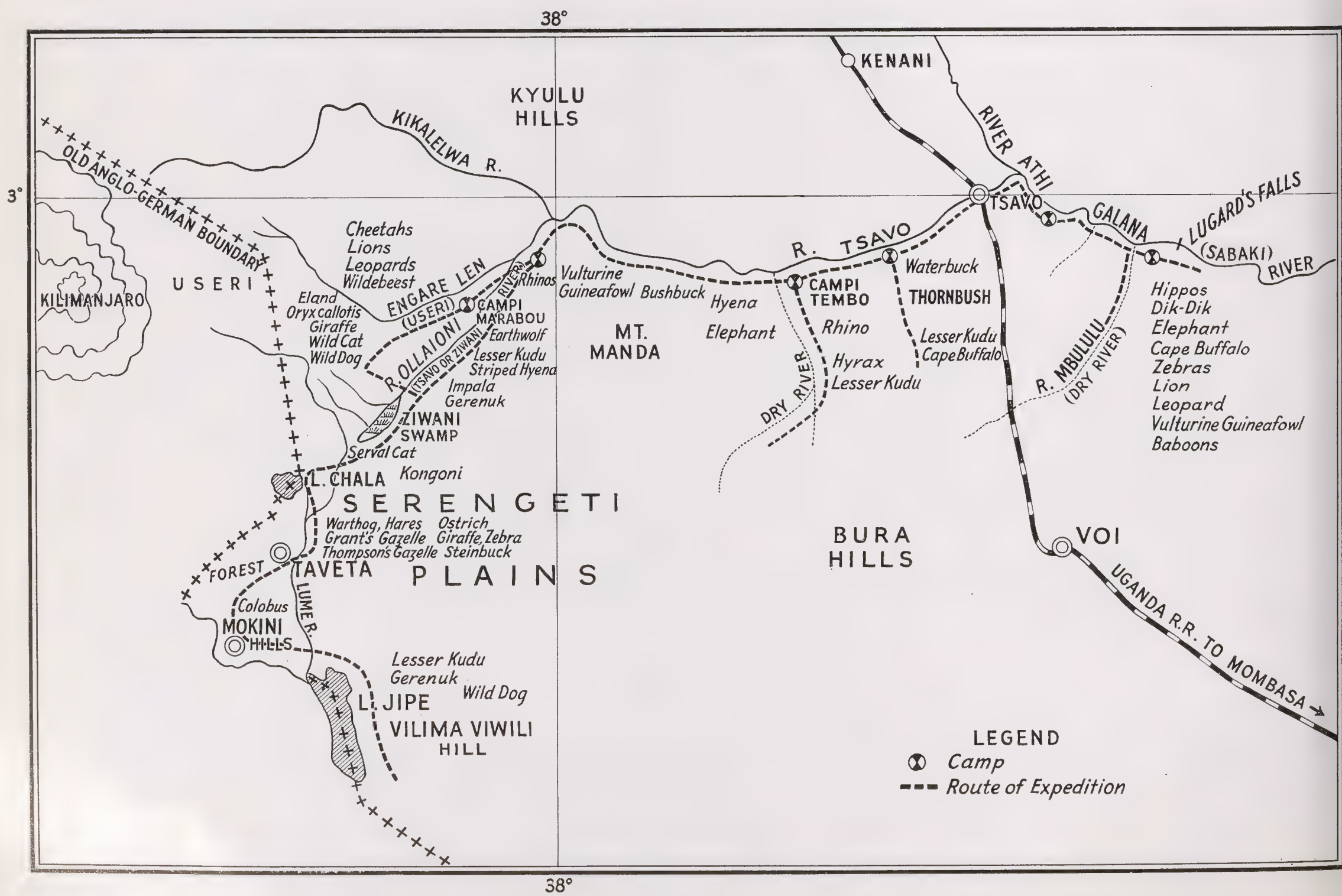
Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 101 Park Avenue, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



From base camps such as this along the Sabaki River, Dr. Bayer and his hunters made long collecting trips into the bush. The author is shown seated in the center of the picture, and behind him, on a stake, is a playful grivet that accompanied the party. This camp happened to be in hippopotamus country and their noise at night sometimes made sleep difficult. Below is a map of the expedition's route.



BULLETIN

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Wild Life Along the Tsavo River

A Collecting Party Turned Up Plenty of Game in an African Region that at First Appeared Hopelessly Desolate

LEON BAYER, M.D.

Formerly of the Tropical Institute of Hygiene, Amsterdam

[Having made several trips to Africa as a collector for the Congo Museum at Tervueren, Belgium, Dr. Leon Bayer wrote for the BULLETIN two articles on "Wild Life On and Around Mount Elgon, Equatorial East Africa," in the winter of 1923-24. Further experiences with the abundant wild life of one of the harshest regions of Africa are recounted in the present article. The Tsavo River in Kenya Colony, along which he collected for several months, is reached by a railroad that was put through at the end of the last century, but away from the railroad the wilderness remains virtually untouched and as forbidding as it was when Dr. Bayer passed through in 1913. The Taita District is within the range of many of the African animals now or previously exhibited in the Zoological Park and his article will be found unusually interesting on that account.—Editor.]

"WHAT fauna can we expect in a country like this?" I asked myself on first sight of the Tsavo River region. Certainly there could be no great variety in a land so desolate and monotonous, a land of stone and sand, of thorns and rhino grass and bayonet-like sansevieria with its hard, needle points. Would our results justify the hardship we would undoubtedly encounter?

The heat was fierce and the ground burning as the *safari* entered the thorn jungle along the Tsavo River. An *Androbo kirongozi*, or native guide, was leading and he kept us close to the river, for we were dependent upon its water in that stern and forbidding wilderness. Even so, progress was slow through the thickets of shadeless, prickly trees and *askaris* (the Arab name for soldiers—with us, the camp police) had constantly to work ahead of us and cut trails through the bush for the porters.

One of our first camps was established close to the Tsavo at the mouth of a dry river and

on the following day we explored its sandy and rocky bed. A few hours' tramping up its course brought us to an open space where the thorn was more scattered and here game appeared.

A few zebras were in sight, a family of warthogs scampered away with tails erect, we saw our first elephant spoor and rhino tracks, a first glimpse of one of the handsomest of the antelopes, the blue-gray striped lesser kudu. It was a first promise that the wilderness might be lively, after all, and with the prospect of plenty of specimens we were resolved to pay no more attention to the discomforts of the thorn thickets.

Exciting times began the succeeding day when we moved our camp toward a needle-shaped, greenish rock posted as a sentry of the Kyulu Hills. Quite early in the morning we came across the spoor of an elephant that had been to the river to drink. They were fresh tracks, for the treaded sand was not yet quite dried by the sun.

Now, as a rule nothing is more tiresome and

The photographs accompanying this article were taken by the author.



For thousands of years the waters of the Sabaki River have been drilling these pot-holes along its rocky course above Lugard's Falls. The polished stones are a sunning-place for crocodiles and the deeper pools are the domain of the hippopotamus.

uninteresting to me than to follow elephant tracks, for elephants walk far and fast and it sometimes takes days to catch up with them. But these tracks were so fresh that we followed through the spine-leaved trees, and at 4 o'clock in the afternoon we came upon the beast in a clearing. The wind was in his favor and he began to move quickly away. The keenness of an elephant's sense of smell is remarkable, like that of a rhino. Its sight, however, is short. If an elephant could see better, a hunter would not have much chance to escape its charge.

Even though the elephant was quickly almost out of range, I fired, and hit. He kept on and there was nothing for us to do but to follow, tired as we were from having had no rest since early morning.

Half an hour later we came to shady cover. My companion was in the lead; I followed ahead of our men and the mules. Without warning the wounded elephant was upon us, uttering a horrid scream as it charged. My companion dropped. I had barely time to jump to

one side and escape the first rush. Beyond me the elephant halted at a tree and broke off a thick branch which fell among the mules. They broke loose in a panic and two of our drivers were knocked down and injured.

In the confusion the elephant's attention was diverted from me to the mules. Badly placed as I was for a telling shot, I fired with the 350 Rigby rifle but could not hit him in the right spot. In my haste, the next cartridge jammed and I whirled around to take my express gun from the carrier, but the man had fled and had taken the gun with him.

There was nothing for me to do but to stand motionless and trust to the elephant's poor sight to overlook me. I stood there for a few moments, with my heart beating so fast I felt sure the elephant would hear it, and then, as suddenly as he had charged, he lumbered off through the trees and disappeared. When he was well away, my companion crawled out of a hole where he had accidentally fallen directly in front of the elephant, and we rounded up the natives.

We followed that elephant no further. We were happy enough simply that no one had been killed.

The next day we found one of our mules where it had wandered back to an earlier camp. My mule was lost and it was only later, while reading Mr. Denis Lyell's "Memories of an African Hunter" that I learned what had become of him.

"I remember the case of a mule which had been lost for two months," Mr. Lyell wrote. "Seen in a cattle boma, effort was made to catch him but the animal jumped the boma and got away. Query: what was the beast doing there? He had jumped a high thorn barrier to get in. That mule had been lost under sensational circumstances. The party of sportsmen to whom he belonged were charged by an elephant which knocked down a tree upon the syce who was holding the animal, causing him to let go. How that mule contrived to rid himself of saddle and other gear, he only could have told. Sometimes a mule will break away and stay away. It is rarely recovered; gregarious of instinct, the

animal throws in his lot with a troop of zebra and remains with it until it falls victim of a lion, for it is lacking of the veldt knowledge."

Half way between the Tsavo Station and the Ziwani Swamp we reached a beautiful spot. Tall, spined mimosa trees lined the banks of the river, which was broader at this point, and there was open space for a comfortable camp. The spot had already been chosen by the elephants and for that reason we called it "Campi Tembo," the Swahili name for the elephant.

I was especially interested in the lesser kudu and here was really his home. That beautiful antelope, which ranges to Abyssinia, subsists chiefly on the leaves of the bush scrub. Going for water in the morning, the kudu then slowly returns to the stony interior. It is good sport to follow his spoor through the scrub, but if one notices little dome-like thickets, it is well to approach them carefully, for a kudu may jump out. These characteristic refuges are covered by large green leaves and are generally empty, but not always.

Tracking kudus in such country is a sport



In the damp neighborhood of the Ziwani Swamp the vegetation became more luxuriant and in such quiet pools as this, the beautiful phoenix palms and mimosa trees were reflected as in a mirror. This pool was near the expedition's Camp Marabou.

that can be quite effectively spoiled by an encounter with a rhinoceros, either roaming or resting. A resting rhino is likely to be the more disagreeable. Warned by his sentinels, the oxpickers, (*Buphagus erythrorhynchus*), he jumps up and wheels around, screaming and snorting and trying to make out from the scent

divide again once or twice. But we were still in the country of the scrub jungle and it spread out to the Serengetti Plain.

After a long march we camped half an hour before sunset. The *askaris* began pitching the tents, the porters were collecting wood for the cooking and camp fires, others were carrying



*Typical of the Tsavo River region is this scene of thornbush and rocks and scattered trees of larger dimensions. In the center of the picture is the slender palm of the *Hyphaena* species, with bifurcated stem and branches that divide again.*

from which direction danger is coming. Generally, if you stand quite still, the huge brute will trot off with head and tail both elevated. But in his going he arouses all the game in that section.

We had an encounter with rhinos about that time. While the porters were following a rhino track back down the river, looking for a new camp site, they ran head on into two of the beasts. The scared boys dropped their loads and jumped for the nearest trees. The stupid animals let them go and pleasantly tossed several boxes in the air with their horns. One box happened to contain the metal cooking gear and when it was tossed it made such a clatter that it frightened the rhinos away.

More open country appeared as we approached the Engar Rongai, more grass and groves of an interesting palm of the *Hyphaena* species with bifurcated stem and branches that

water. The heat all that day had been intense and our Meru porters, accustomed to the air of the slopes of Mt. Kenya, seemed discouraged. The heat and homesickness were beginning to upset them. Some were actually sick and in my first free minutes I took care of them.

Then, as night came on rapidly, I made my usual count to see that everyone was at his post. One man was missing.

Calling up the *Nyampara* (headman), I asked for an explanation. It was simple and brief. The missing man had fallen sick; he was too weak to travel under his own power. So his comrades had taken all his possessions and had laid him out comfortably in the shade of a tree some miles back, abandoning him to the death that they considered inevitable.

Without wasting time in scolding, I gave orders for a party to be formed to go after the man and bring him into camp, dead or alive.

With hurricane lamps and an *askari*, the party started back over the trail and much later that night they carried him into camp. They deposited their human package beside the camp fire, obviously considering it not worth the trouble it caused them, and turned the man over to me.

The man did, indeed, seem all but dead—as well he might have been under such circumstances. I rubbed him thoroughly all over with liniment, forced medicine down his throat, gave him a hypodermic injection. Then I rolled him in a blanket and moved him close to the fire.

An hour later he showed signs of reviving and I doubt if the astonishment of his companions that he had come back to life was any greater than his own. That a white man should have lavished such attention on him seemed incomprehensible. I remember yet how his oily, grateful face shone in the light of the flickering camp fire, and the glitter of his eyes as they followed my every movement was touching.

Three or four days later the man was completely recovered. He had escaped the law of the wild. The jackals could yelp, the hyenas snarl and howl near our camp at night, but

their infernal laughter would not express their joy as they tore at his carcass.

It is said to be the custom of a few primitive people to expose very old or dying people outside their *kraals* to make a feast for the night beasts. It would be a bad omen if they died in the camp; it would mean more deaths were coming. Apparently such procedure was within the philosophy of our men, for on this occasion it was the uncle of the sick man who had ordered him left behind.

The further we penetrated into that seemingly desolate country, the more I wondered that I could ever have been skeptical of finding a variety of game. There were comparatively few spotted hyenas, but the striped hyena, although a solitary animal, was plentiful enough. We collected an interesting animal in the earthwolf, or Aardwulf, as the Boers call it (*Proteles cristatus* ssp.), and a pair of "desert foxes" (*Otocyon virgatus*). Twice fortune gave me the opportunity to run into packs of wild dogs (*Lycaon pictus venatus*). I called them hyena dogs, their heads having an external similarity to those of hyenas. Frequently we encountered



Getting the camp fire going was always the first task when camp was made and the black boys quickly set about gathering wood and carrying water. At this camp, along the Tsavo River, the *Hyphaena* palms can be seen in the background.



(Top). An interesting specimen collected by the expedition was the earthwolf, or Aardwulf, as the Boers called it (*Proteles cristatus ssp.*), a harmless animal feeding on destructive insects. It should be given official protection. (Below). Packs of wild dogs (*Lycaon pictus venatus*) were seen on two occasions, and were collected.

wildcats (*Felis ocreata taitae*), noisy guinea fowl (*Acryllium vulturinum*), serval cats, Grant's gazelle, leopards, cheetahs, baboons, genets of several species including an interesting melanistic specimen of a black serval, rock rabbits (*Heterohyrax brucei hindei*), mountain reedbuck, giraffes, zebras, Thompson's gazelles, wildebeest, impala, gerenuk, elands and many other species of game.

The unexpected seemed to be the keynote of the country. Near the Useri River we were camped one day for a kind of a picnic lunch under one of the large acacia trees that bear thorns two inches long, when the boys, in their shouting and roaming about, disturbed a medium-sized python. It slid down the trunk of a tree and headed for the river.

The men were frightened, but some of them gave chase and after a hard tussle in which several tumbled into the water, they managed to kill the serpent.

I never had any bad experiences with snakes in the whole of my work in Africa. Generally, I found, they try to conceal themselves and will not attack if they are left alone. The natives feared them, however, and seemed unable to distinguish the poisonous from the harmless ones.

I sometimes saw green-colored snakes lying on branches, or found the slow, brown puff-adder (*Bitis arietans*) in the road ahead of me. Occasionally the swift black mamba, the "deadly mamba," as it was called (*Dendraspis angusticeps*), came into our view. Once only I encountered the spitting cobra (*Naja nigricollis*), but he was searching for cover and unwilling to cause trouble. I stood well away and tossed a stone to see what would happen. Instantly the snake reared up, expanding its hood, and faced me. If I had been nearer I might have gotten a spray of venom in my eyes. There were many large black scorpions under dead leaves along the river bank, or under the trunks of fallen palms, but they never caused any trouble.

Southeast of Kilimanjaro, at the foot of the mountain and not far from Taveta, the Mokini forest gave me an opportunity of collecting several specimens of the long-furred black and white monkeys (*Colobus c. caudatus*). That beautiful forest was well watered and moss

hung thick from the very high trees. In such surroundings it was quite difficult to detect the colobus monkeys, although they were numerous. In the neighborhood of native settlements we found the "black forest-monkey," (*Cercopithecus leucampyx kibonotensis*), a real nuisance to agriculture because they persisted in plundering the native planting. They are very nimble and protect themselves by running through the grass or undergrowth, but if they are pursued by dogs they become panic-stricken and leap for the trees, where they can easily be shot.

As we diverged from the forest and crossed the Lume River with its border of dense vegetation, we found ourselves again in open country and for the first time met with the baobab (*Adansonia digitata*), leafless at that time of the year but bearing its great, sausage-like fruits called "monkey bread." This giant tree is characteristic of all the coastal regions of tropical Africa and is one of the world's largest plants, sometimes reaching a circumference



In the high, moss-hung trees of the Mokini Forest was found a handsome species of Colobus monkeys.



When Dr. Bayer came upon this huge Euphorbia in the thorn jungle inland from the Sabaki River, an elephant was resting in its shade. The beast winded the approaching hunters, however, and disappeared in the bush to play hide-and-seek.

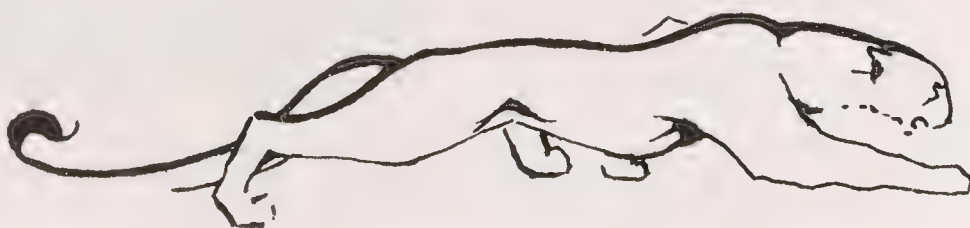
of 100 feet at its base and a domelike spread of branches of 800 feet.

Our journey came to an end near the M'kuyu River in a shady and inviting spot. Close by, a hillock emerged from the grassy plain and the stunted bush. From the little eminence I could spy out ostriches and giraffes, a herd of neighing zebras, a warthog and her active litter grunting and rooting about with no heed for two maneless lions that trotted along some distance beyond.

It was a true African scene and as I turned back to our last camp I felt a premonition of the nostalgia that would seize me so often in the time to come. At sunset that evening a rhinoceros crossed beyond our camp and fol-

lowed a trail along the elevation; I saw him standing there with his head up, facing Kili-manjaro as the sun was dipping behind the slopes.

"Last witness of the prehistoric days of the earth's history, and now so near extinction in spite of all attempts at preservation," I thought as I watched him, for I was sad and already homesick at the prospect of leaving Africa. "What will become of the present-day primates, the race that kills? Will the last of us also stand a million years hence, as that poor beast is standing, facing the declining sun and trying to protect ourselves, relics of an earlier epoch? Evolution cannot be stopped and there is no time in eternity!"



A Trip to Trinidad

Dr. Ditmars Visits the Home of *Pseudis paradoxis*, a Remarkable Frog That Passes Through an Enormous Tadpole Stage

RAYMOND L. DITMARS

WITH a view of combining a holiday trip and study of the life history of *Pseudis paradoxis*, a remarkable frog of the American tropics, the writer journeyed through the West Indies to Trinidad, leaving New York on September 10 and returning on October 5.

The round trip was made on the R.M.S. *Nerissa* of the Furness Withy Line, the stay at Trinidad rendered possible by the ship continuing to Demerara and returning to Port-of-Spain about a week later.

While there is not much time available for shore trips at the ports visited by a combination cruising and cargo vessel, there is much of interest to be noted in a trip through the Leeward and Windward Islands. There are indications of renewed volcanic activity along the chain of islands. The crater-like gashes on the old volcano at Montserrat are emitting heavy sulphur fumes and the odor may be detected several miles out at sea. Several vessels have reported that when at anchor about a mile offshore, with the wind blowing from the island, the brasswork turned black and was very difficult to polish. The volcanoes on St. Vincent and Martinique appear to be more fissured at their summits and from Mont Pelée, for the first time in several years, I noted a dingy trail of fumes from the crater.

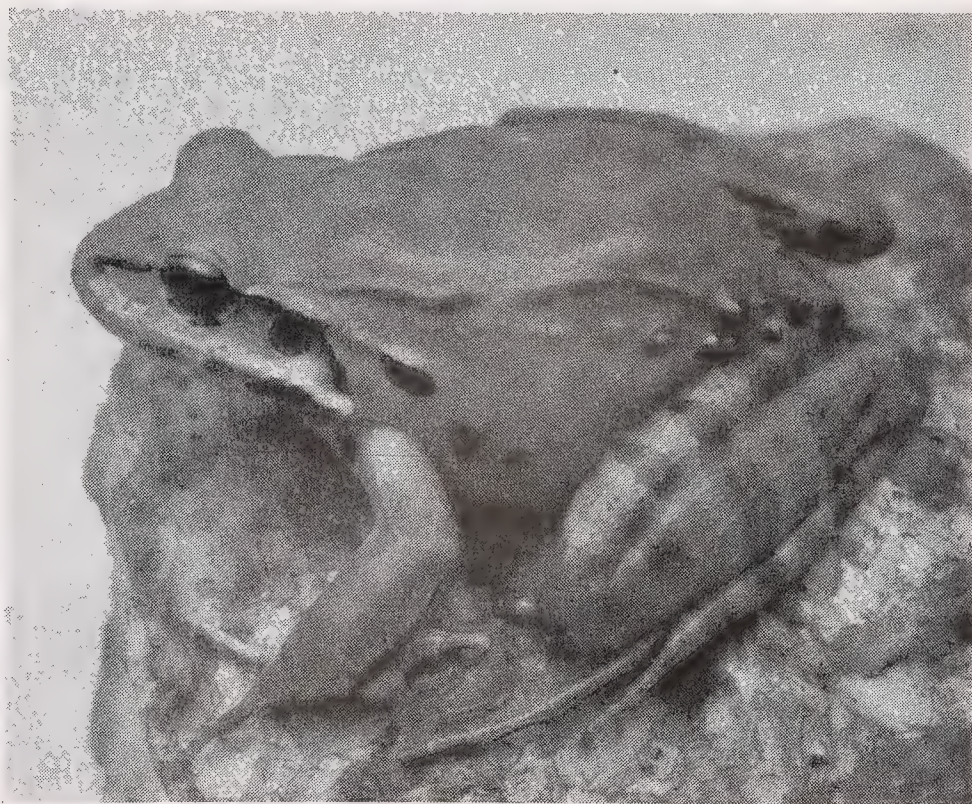
Martinique is particularly interesting because of the opportunity to drive by automobile to the ruins of St. Pierre, whose 35,000 inhabitants were almost instantly killed by a fire avalanche from Mont Pelée in 1902. The Volcanic Museum is of intense interest, the exhibits showing the effect of eruptive heat being really astonishing. There are many enlarged photographs showing recent eruptions, as late as 1929 and 1930.

The drive from Fort de France to St. Pierre is doubly interesting, from anticipation of visiting St. Pierre and the marvelous tropical scenery along the way. It is close to forty miles

and through some of the most imposing luxuriance of hot country vegetation to be seen anywhere. The lofty rain forests draped with vines and lianas, horizontal branches of the big trees that are veritable botanic gardens of various orchids, and the canyons with magnificent tree ferns create spectacles long to be remembered. Unfortunately the road is an interminable series of curves and grades and the driving of the native chauffeurs is utterly reckless, although they do keep up a loud tooting of bulb-operated horns.

At Dominica I purchased for a shilling apiece two dozen of the large and handsome bronze frogs known as "mountain chickens." These frogs make attractive exhibits and, luckily for the collector, are sold in the market place. Formerly they were found on adjacent islands, where their present extinction is attributed to the mongoose.

Regarding this mammalian pest among the islands, I again heard reports that the mongoose appears to be deteriorating. The island boas, I was told, have acquired the habit of stalking and eating them. The fer-de-lance is



A "mountain chicken."



Repeated seining of this palm-bordered pond brought to light a few small tadpoles of the Paradox Frog, but none of the giant specimens which are known to occur in it.



Two views of the single Paradox Tadpole that reached New York alive, both taken after it had lost fully a third of its length by dropping a portion of its tail. Normally the tail is absorbed as the tadpole is transformed into a frog.

now said to be particularly prevalent in a rocky portion of St. Lucia.

At Barbados I had the pleasure of meeting Professor M. Abbadi, a French collector who has a considerable exhibit of reptiles from various islands. He showed me a particularly beautiful iguana, about five feet long and of a vivid green color. It appeared to represent the subspecies *rhinolopha* of the big iguana inhabiting South America. Dr. Thomas Barbour provisionally included this subspecies in his Antillean list as once occurring on St. Lucia, but now regards it as rendered extinct by the mongoose. Professor Abbadi insisted that his strikingly-colored lizard was not rare and gave me the name of the native collector who had guided him. Unable to get in touch with the man while

the *Nerissa* was in port, I sent a radio message back asking that specimens be caught and held for me on the return trip, but as I passed through the islands homeward bound I found that there had been insufficient time to collect specimens. In the coming year I hope to investigate further the status of this lizard and, if possible, to collect it.

The fauna of Trinidad is very different from that of the West Indies, being more like that of South America. A number of important species of mammals and reptiles occur and others of the nearby mainland are curiously lacking. I have collected during the last three years in Trinidad, bringing to the Zoological Park species that have never previously been exhibited alive in zoological institutions. The giant bats

of my 1935 trip have bred and reared young in the Park.

On arriving at Port-of-Spain this summer I was depressed to learn that my good friend, and the friend of so many scientists, Professor F. W. Urich, had suffered a paralytic stroke and was confined to the Colonial Hospital. I hastened to see him and learned that it was anticipated that he would be up and around again in a few months.

I had expected to visit with him many parts of the island with which he is so familiar, but determined to spend as much time with him as possible and so made but one collecting trip. That was to Mayaro, where there are the only ponds on the island inhabited by *Pseudis paradoxis*, the "paradox frog" which in the early stage of its life history reaches the enormous length, for a tadpole, of fourteen inches, subsequently shrinking in body bulk to a quite diminutive frog of about two inches' length.

The pond was seined, but the few tadpoles brought up were found to be very immature—

from two to three inches long. In this stage they are gelatinous and extremely delicate. All but one died on the sixty-mile journey back to Port-of-Spain from Mayaro. The single survivor, however, reached New York alive and the others were consigned to alcohol jars as museum specimens.

As the pond inhabited by *Pseudis* has been subject to invasion by young caimans from the Nariva mangrove swamp, and the presence of carnivorous eels was well attested by our net hauls, definite protection of this interesting spot is now contemplated. The pond is at the edge of the extensive area of coconut palms owned by Mr. Paul Urich and we discussed making eel traps and methods of catching the little caimans. Mr. Urich is determined to make the spot a sort of sanctuary for the study of *Pseudis* and from the experience of my brief reconnoiter I look forward to a longer stay and more extensive preparations in collecting specimens of the paradox frog tadpoles in the coming year.



Another habitat of the Paradox Frog in Trinidad, a pond close by the ocean beach.

Lobster Hatcheries to the Rescue

Millions of Hatchlings Are Planted in American Waters Each Year to Preserve a Great Industry in Distress

ROSS F. NIGRELLI

New York Aquarium

THIRTY billion pounds of lobster, by a conservative estimate, have been sent to market in the past fifty years from American waters. And since not even the vast resources of the ocean are unlimited, a great industry has for a long time been facing increasingly hard times, from which laws aimed at conservation and the strenuous efforts of biologists are at last beginning to relieve it.

Inroads on the supply of what then must have seemed an inexhaustible food began early in American history. Crustaceans of one form or another have, of course, been used as food for many centuries and the early settlers of this country were quite willing to accept the American species of lobster, *Homarus americanus*, because of its similarity to the European lobster found on the shores of the British Isles and the whole western coast of Europe from Norway to the Mediterranean.

The Pilgrims found *Homarus americanus* particularly abundant along Massachusetts Bay and it is recorded that in 1623 "when the ship *Anne* brought over many of the families of the earlier Pilgrims, the only feast of welcome which [was] offered was a Lobster, or a piece of fish, without bread or anything else but a cup of spring water."¹

While the New England and New Brunswick coast has always been the most important center of the lobster industry on this side of the Atlantic, the crustacean actually ranges from Labrador to North Carolina. It is not found naturally on the Pacific coast, although transplantation was attempted there as far back as 1873. The first attempt was not successful but subsequently large numbers of lobsters and larvae were successfully transplanted at Trinidad Head and Monterey, California, by Dr. C. H.

Townsend, then with the Bureau of Fisheries vessel *Albatross*. From time to time some of those lobsters have been recovered but the species has not as yet appeared in any great numbers.

Whatever results may be obtained in the future by transplanting experiments in the Pacific, the north Atlantic coast will probably long remain the most important lobster area. It is generally true that the northern part of its range provides lobsters of greater size and abundance, but nevertheless the largest individual specimens captured have been taken along the New Jersey coast.

One of the largest of these weighed 34 pounds and was 23³/₄ inches from the tip of the rostrum to the tail. When measured from the tip of the extended claws, this giant lobster reached almost four feet in length. It was exhibited at the Aquarium several years ago and may still be seen as a mounted specimen at The American Museum of Natural History. In recent years many lobsters weighing from 15 to 25 pounds have been taken by flounder fishermen in their trawl nets.

The adult lobster derives its color from the dissolved pigments in the blood, or granules present in the protoplasm of certain cells, called chromatoblasts, in the soft skin just beneath the hard covering. These cells excrete the pigment which eventually comes to lie in the shell, and because of a chemical substance called chromogen, this pigment has peculiar properties. Easily affected by prolonged exposure to strong sunlight, dehydration or oxidation, chromogen may be converted into one of several colors. Anyone familiar with the lobster knows that it takes on a red color when placed in boiling water or alcohol, but these changes do not necessarily occur only after death of the organism sets in. Thus, from time to time, the

¹ Herrick, F. H. (1909). Natural History of the American Lobster. *Bull. Bureau of Fisheries*, Vol. 29.

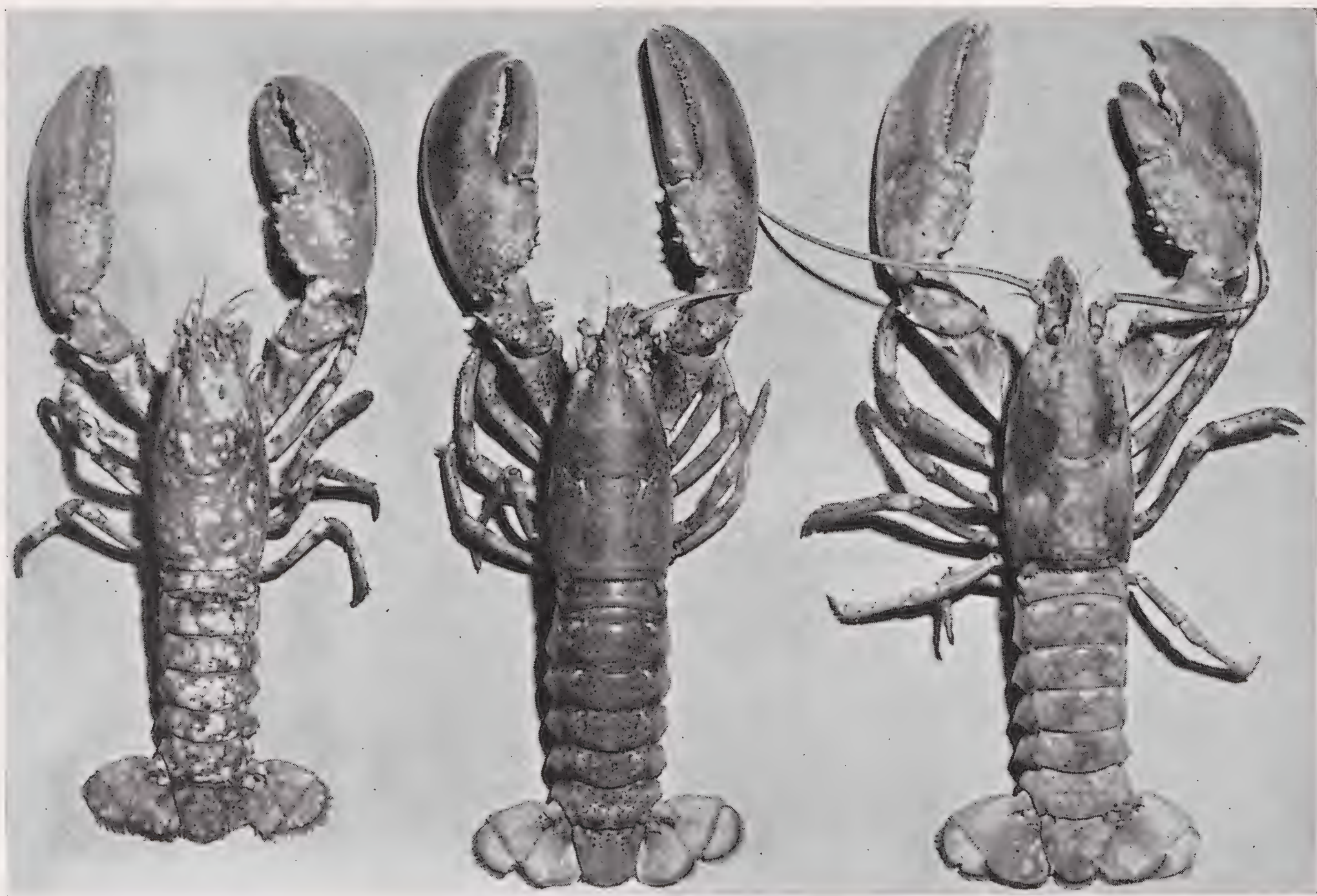
Aquarium has had on exhibition live lobsters of a red or blue color.

The exact causes of these changes in the living animal are not definitely known. It has been reported that exposing the lobster to strong sunlight for long periods will cause it to turn blue. It is definitely known that any strong physiological disturbance will result in change of color. Occasionally, lobsters with a mottled appearance of green, blue and cream have been encountered, as well as spotted or "calico" lobsters with a pattern of these same colors. Such lobsters were recently exhibited at the Aquarium. On one or more occasions black lobsters have been reported. These, however, were probably melanistic and cannot be considered in the same category as those described above.

The food of the fully grown and matured lobsters consists chiefly of fish and invertebrates. As they have cannibalistic tendencies, the larger and stronger also prey upon the small and weak.

The molting is the result of growth and commonly occurs during the summer months. It begins on the second day after hatching and occurs at intervals throughout life. In the first year the lobster sheds about fifteen times. The number of molts is reduced in succeeding years so that when it is about five years old it has molted approximately twenty-five times. These shedders—weak and easily damaged when handled—are not fit for market. Soft-shelled lobsters take about eight weeks to harden and are usually kept in lobster pounds until the hardening process is complete.

Lobsters $10\frac{1}{2}$ to 11 inches in length are usually mature. In the spring they migrate inshore, moving offshore to 100 fathoms of water in the fall. Spawning takes place every two years and lasts about six weeks, during the months of July and August, the number of eggs varying with the size of the individual. Thus, an 8-inch lobster produces 5,000 eggs; one 10 inches long, 10,000; a 12-inch lobster, 20,000,



Possibly half a dozen strikingly colored lobsters such as these are taken each year at the Connecticut State Hatchery. Left: a "calico lobster," mottled cream, blue and reddish brown. Center: a blue lobster. Right: calico, with predominant cream.

etc., up to a length of 16 inches. From then on the number of eggs laid is not necessarily correlated with the size.

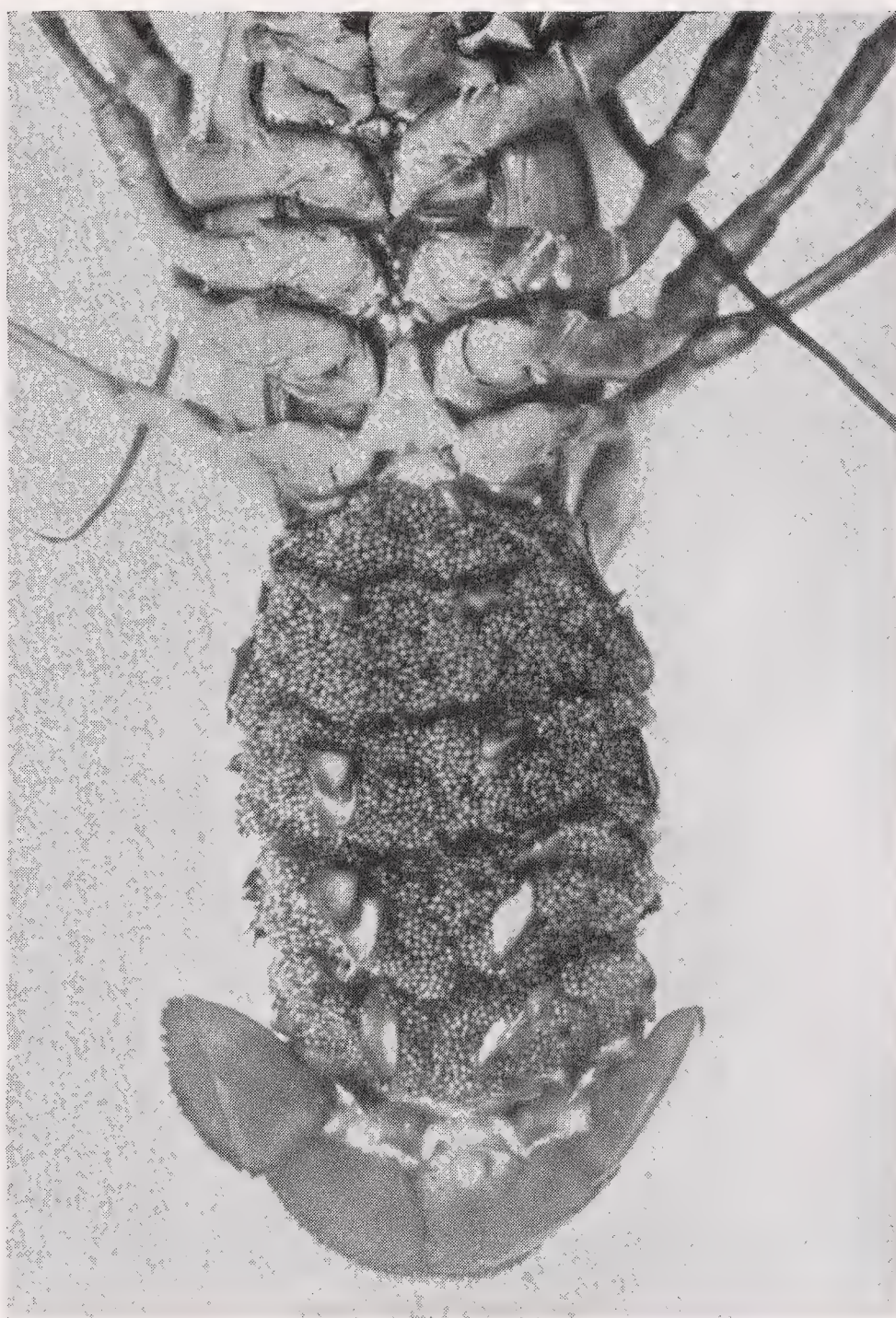
Conservation measures and technical assistance to supplement nature in the increase of the lobster supply have been in operation for a great many years and there is no doubt, now, that to them the industry owes its preservation. As a measure of the decline, however, despite all efforts to conserve and increase the supply, it may be noted that the Bureau of Fisheries estimated the catch along the New England coast at 30,000,000 pounds in 1889, whereas today the annual catch is less than 10,000,000 pounds.

The income of the lobster fishermen has fluctuated widely during the past fifty years, as wholesale prices for his catch have ranged from 2 cents a pound to 50 cents and more. At the present time, the wholesale price is about 45 cents a pound. On the basis of the actual edible portion, the price is considerably higher, for only 27 per cent. of the whole lobster is meat.

Faced with a lobster supply that had declined two-thirds in the richest area and even more in some others, lobstermen sent up a loud cry for help and the Bureau of Fisheries set about to determine ways and means of increasing the yield. As a result of early studies three things happened: (1) the passage of strict laws with imposition of heavy fines and jail sentences for the taking of undersized lobsters or "shorts;" (2) the establishment of lobster hatcheries at different points along the coast; (3) attempts at transplantation of lobsters in order to establish new lobster grounds in the United States.

Many of the states have passed rigid laws as to the size of lobsters that may be caught. In some states the legal measurement constitutes the distance from the eye-socket to the posterior margin of the carapace. Thus, in New York the legal size is 3 1/16 inches, while in Maine it is 4 3/4 inches. However, it takes about five years for a lobster to reach the legal size and six years to reach maturity. It has also been established that only about one out of 8,000 ever reaches maturity. Therefore, such laws affecting size, although helpful to a certain extent, have not solved the problem of enhancing the supply.

Attempts were then made to culture the or-



U. S. Bureau of Fisheries.

A "berried" lobster may carry 20,000 eggs. Normally the larvae are hatched while the eggs are still attached.

ganism. This called for cooperation between the lobstermen and the experimentalists. The former, realizing their predicament, were more than willing to cooperate with the Federal and state biologists in their work at the lobster hatcheries. Their part was simple enough, for all they had to do was to turn over, during the breeding season, all the berried lobsters caught in their traps. This they were willing to do, for not only were they paid for each berried lobster (at market price), but the individual lobsters were returned to the identical location at which they were obtained. Thus, the lobstermen had another chance to trap the same prey.

The technique at the hatcheries is now more or less standard. The berried lobsters are collected during the breeding season. The average size (12 inches) produces about 20,000 eggs. These are well protected by the female so that in most instances a higher percentage of hatch



Outside hatching troughs at Noank, Connecticut. In the upper level the newly caught "berried" females are placed and as the larvae hatch they are washed down to the lower troughs by a constantly flowing and gentle stream of water.

occurs than if the eggs were stripped. According to statistics furnished by the Bureau of Fisheries, Rhode Island has shown a steady increase in its annual catch, from 500,000 pounds in 1905 to more than 1,000,000 pounds in 1908, and more than 1,500,000 pounds in 1924. This tremendous increase is believed to be the result of lobster culture.

Three conditions are absolutely necessary for the successful propagation of lobsters: quick renewal of water, cleanliness and suitable food. Two types of apparatus are required—one to hold the berried females until hatching occurs, the other to carry the larval lobsters through the various stages of development. The first of these is a modification of the cod hatchery trough. A partition divides this trough lengthwise into two compartments. Crosswise partitions further divide the trough into a number of compartments on either side. The entire trough is mounted at a slight angle so that a slow current flows from one end to the other. In the

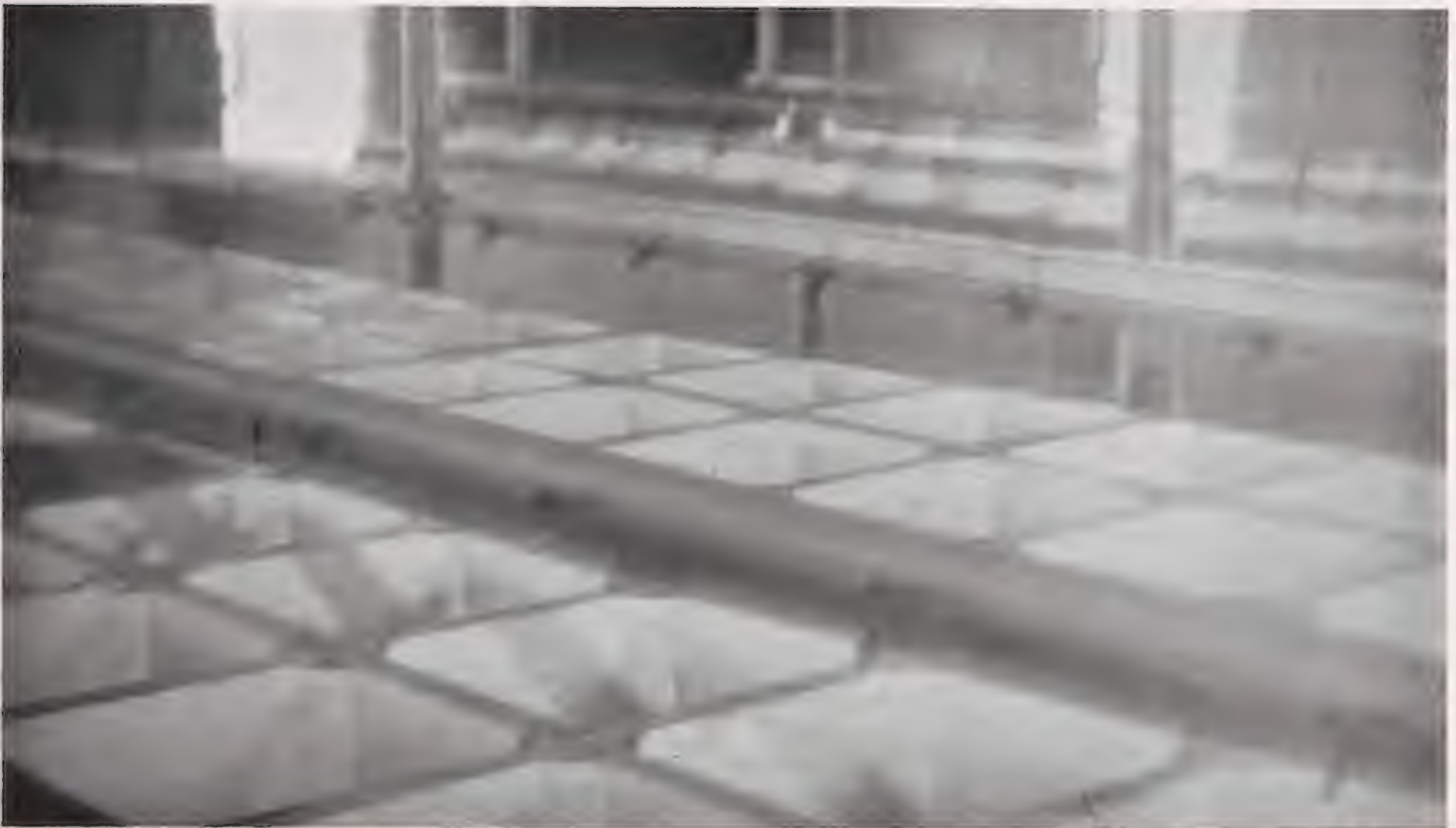
first compartment one berried lobster is placed on each side. The last compartment contains a silk-lined box or net to catch the larvae as they drift down with the current. During the time that the lobsters are held in the troughs they are fed on fresh fish.

The larvae are collected each morning and placed in rearing boxes. These boxes are about eighteen inches square and are painted with white enamel. At the hatchery at Noank, Connecticut, 3,000-4,000 of the newly hatched forms are usually placed in each box.

The most difficult problem encountered in rearing lobsters is the tendency of these forms to practise cannibalism. These small lobsters are voracious feeders and will continue to devour each other until only the strongest ones are left. One way of preventing such a disaster is to keep them continually agitated. In the outside boxes at the Rhode Island State Hatchery at Wickford, this was accomplished by a propeller-like mechanism. At Noank and other

In the Wickford, Rhode Island, hatchery all stages in the development of the young lobsters from hatching to the fourth or lobsterling stage take place in one tank. "Berried" females are placed in the tanks, called "live cars," and every twenty days the lobsterlings are removed for planting. Propellers keep the water in motion to prevent the cannibalistic young from devouring each other.

U. S. Bureau of Fisheries.



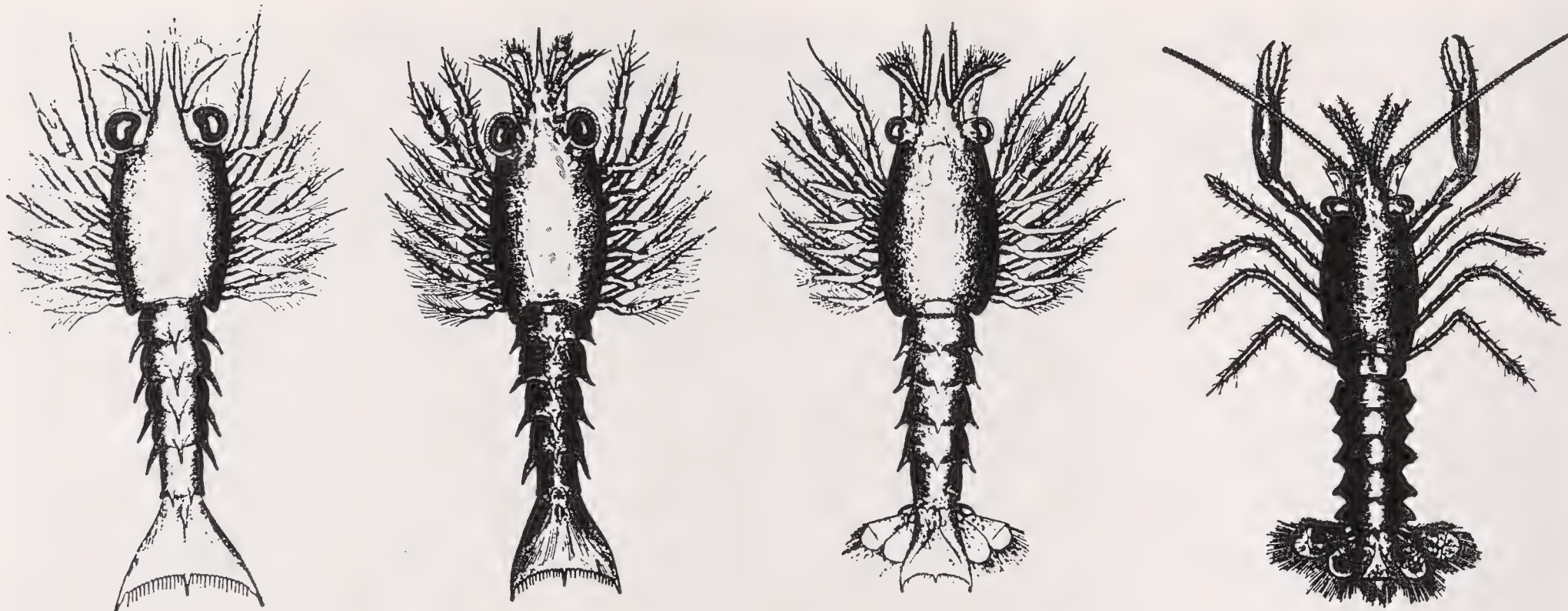
The Noank hatchery removes the larvae from the outdoor troughs after they are hatched, and places them in these rearing, or moulting, boxes. Here they are fed and go through their development to the lobsterling stage before planting.

places where the units are smaller, the same effect is obtained by a strong flow of water forced out through minute openings from the bottom of a standpipe-like arrangement.

The larvae are fed various kinds of food and

of all those that have been tried (yolk of egg, clam meat, cod liver, etc.), beef liver and crab meat were found to be the best. The beef liver or crab meat is ground fine and kept on ice.

The larvae are fed every hour or so, day and



U. S. Bureau of Fisheries.

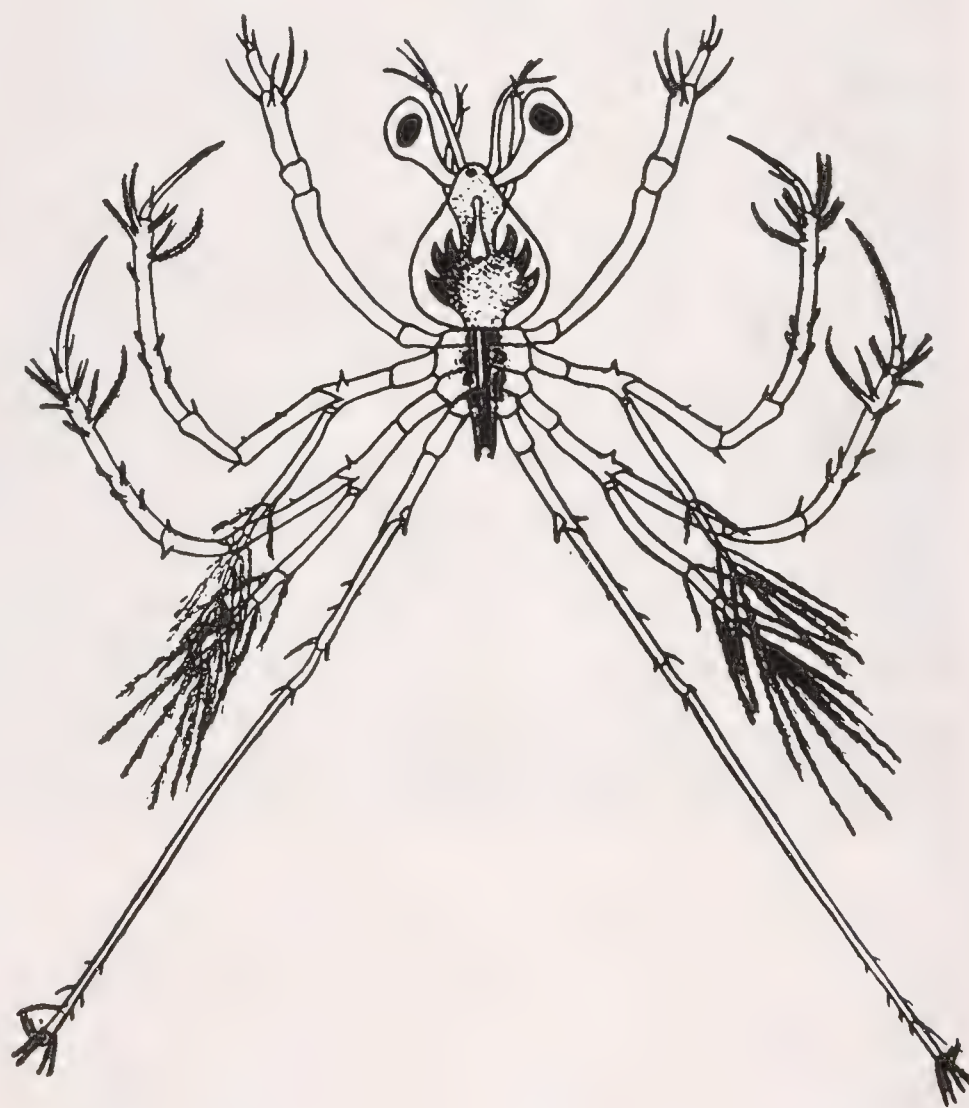
Left to right: 1st, 2nd, 3d and 4th stages in the development of lobster larvae.

night. The food is mixed with sea-water and poured into each compartment through filters. In the earliest stages of development the food is filtered through a 0.1 square inch mesh. This size is increased as growth takes place. However, at Noank, exceptional results were obtained from the use of a clear liver solution. The advantages derived from such a method of feeding are numerous, and the contributing factors are that the water is kept clear at all times and that each box can be kept under continual observation.

The consumption of a nutritive substance that readily dissolves in water brings forth a biological speculation which has attracted the attention of ecologists for some time. There is a prevalent theory (Pütter's theory) which states that aquatic animals can obtain nutriment directly from dissolved substances, but there is much evidence contradicting this statement. If the larvae hatched at Noank do grow, as a result of feeding on the dissolved liver, then the theory has acquired important data to substantiate it. However, critical experiments are still necessary before this can be accepted as evidence, for out of the 3,000-4,000 larvae placed in each rearing box, 300-1,200 fourth stage lobsters, or lobsterlings, are taken out. Thus, it is altogether possible that those which did not come through were used as food by those that survived. If this is so, then part of the growth at least must be attributed to the intake of solid food.

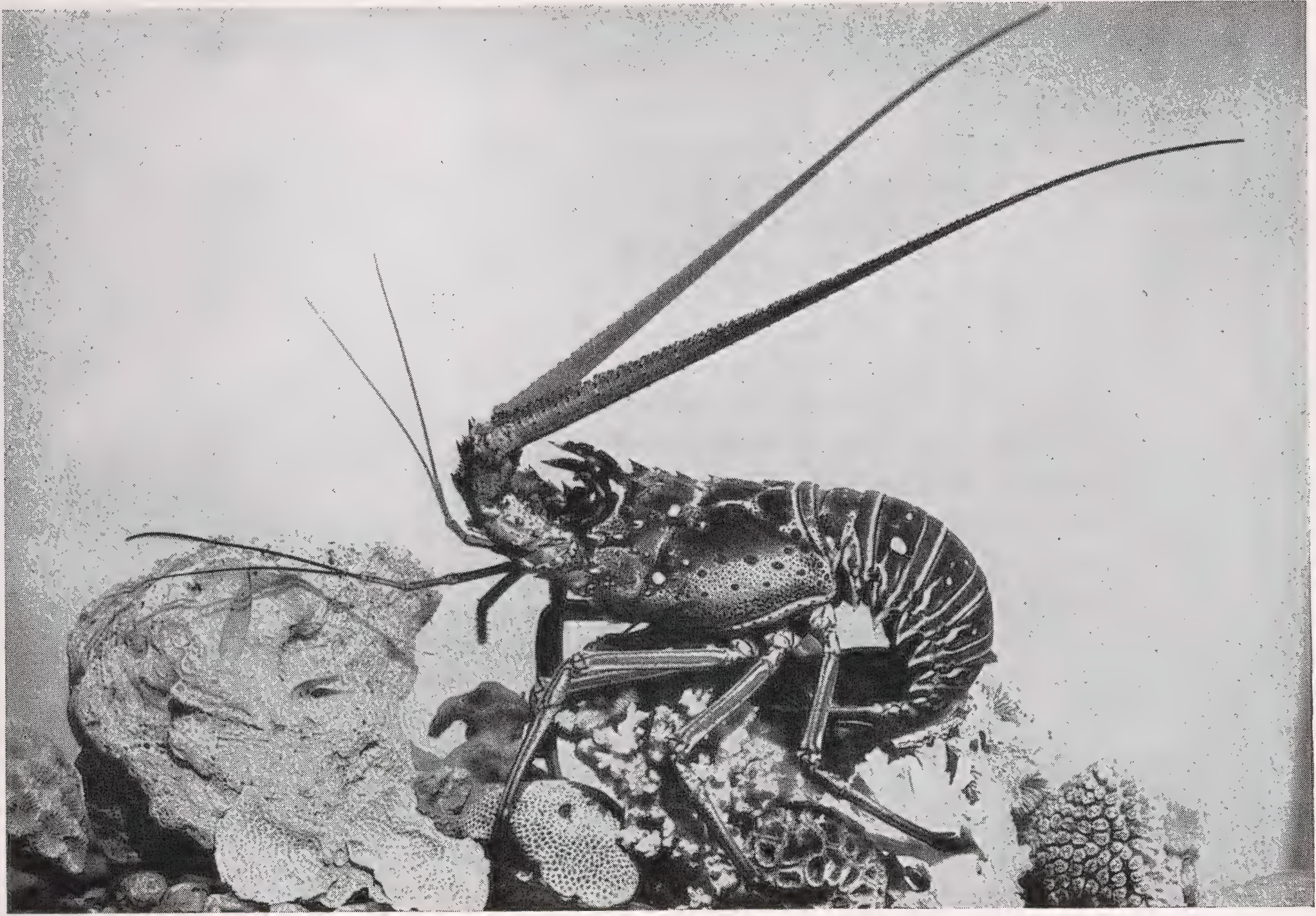
It takes about twenty days after hatching to reach the fourth or lobsterling stage. Twenty-

four hours later—after hardening of the shell has taken place—the lobsterlings are planted along reefs. The Noank State Hatchery has planted more than 500,000 lobsterlings this year. There are two essential reasons for attempting to transplant the American lobster to other waters along the North American coast: one is to propagate the species, which has become depleted because of many years of successful "fishing," and the other is to introduce



U. S. Bureau of Fisheries.

An early larval stage of the spiny lobster, part of a long development.



The spiny lobster, or southern crawfish. Its development is so slow and complex that few efforts have been made to rear it in hatcheries, as is done for the American lobster.

a new product to a region that is lacking in this important and edible crustacean.

Hatching experiments have been attempted with the southern crawfish or spiny lobster (*Panulirus argus*). This species is found in the West Indies, Bahamas and Bermuda. They are not true lobsters, and members of the genus of this crustacean—found practically around the world in tropical and semi-tropical waters—are clawless and possess five pairs of long, delicate feet. The hatching season extends from February to June or early July. The number of eggs carried by a female depends upon its size, varying from 500,000 to 700,000. Artificial rearing of these forms is more difficult because the larval development extends over a long period of time, during which a gradual change takes place, from a curiously shaped larva, or phyllosome, to the adult form. However, hatching and rearing of this species has been successful to a certain degree.

The technique employed is somewhat similar to that for the northern lobster. Instead of

allowing the berried lobster to hatch its own eggs, they are stripped and placed in McDonald jars. About 2,000,000 eggs to each jar were found to give the best results. At the height of hatching, according to the United States Bureau of Fisheries, "the jar has the appearance of animated popcorn." The newly hatched larvae are carried away by a strong flow of water to a retaining tank and are reared in McDonald tidal boxes. From May 20 to July 23, 1928, about 39,000,000 larvae were hatched and planted at Key West, Florida.

The experiments of the United States Bureau of Fisheries have not been such as to encourage the artificial propagation of the spiny lobster. The larvae are too sensitive to slight changes in their environment, are easily injured, very minute, and have to be fed with the greatest of care. The presence of silt in waters at Key West has been found detrimental to the hatching experiments. It adheres to the appendages of the fry and carries them to the substratum, where they perish.

“Home Grown” Birds in the Park

An Argus Pheasant Sets an Eastern Record by Hatching a Chick and It
Was a Good Season for Ducks and Geese

LEE S. CRANDALL

SINCE the days of the founding of the Zoological Park, a great many species of birds have reared their young here, a number of them recording the first instances in captivity. Of late years, however, our activities in the field of breeding have been greatly lessened. Most birds require space to give them the privacy and seclusion necessary for successful nesting, and continued expansion of our various installations has so restricted available areas that fewer and fewer birds can be persuaded to reproduce.

Also, there is the question of disposition of the young. Some day, perhaps, zoological gardens may become breeding reserves, each specializing in a few species best suited to local conditions and keeping, in addition, such odd specimens as the others may be able to spare. The constantly increasing restriction of exportation from the world's great faunal areas indicates that something of the sort may very well take place. However, the pressure has not yet become sufficient to affect greatly the general content of zoological collections and surplus birds are not always disposed of readily.

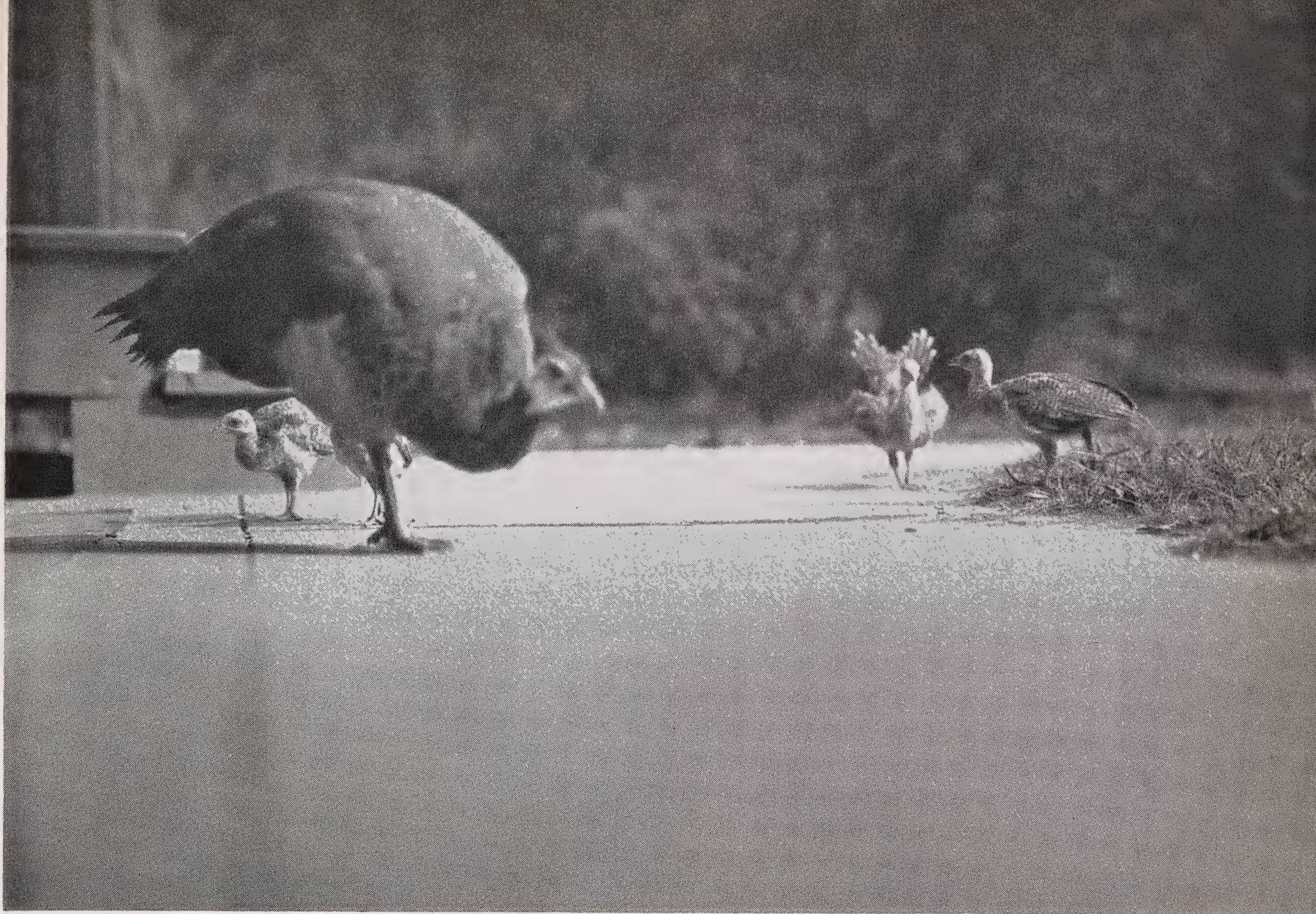
We were very proud, in 1915, when we reared our first emu. No one in this country had succeeded previously and this fact, together with the curious reversal of parental roles, with the father incubating the eggs and caring for the young, aroused great interest. During following years, we learned and published many facts concerning the breeding habits of these birds and really acquired a well-developed technique in rearing. Too excellent, perhaps, for while at first we were able to find new homes for our output without much difficulty, emus are long-lived birds and eventually the demand was filled. Perhaps, too, the depression had its effect here, for we found ourselves, like many manufacturers of the period, with an over-stock. Breeding operations have been indefinitely suspended but seven emus are occupying four large corrals.

Sometimes, of course, there is no trouble about accommodating young birds. This is chiefly true for those that live in flocks without quarreling. Among the waterfowl, many of which are flying at liberty, a few more or a few less make little difference. This has been a particularly good season for young ducks and geese, so that during the coming winter we shall probably be feeding more of these birds than ever. But there is no certainty in seasons and there seems to be no likelihood that our ponds will become definitely over-populated.

Since 1917, we have carried along a stock of silver gulls (*Bruchigavia novae-hollandiae*), from Australia. They are kept in the large central cage at the Aquatic Bird House during the winter but in summer they have the freedom of the Flying Cage, where a number of young are reared nearly every season. Our little native laughing gull, too, is maintained in the same manner. Both these gulls are quarrelsome, though social, in their breeding habits, and we have had to erect for them a sort of rookery, with niches to accommodate each pair. This is surrounded by a circle of wire netting open at the top, so that flying gulls may enter while rapacious pelicans, with their eyes on downy babies, are kept at a safe distance.

Indian peafowl have been established at liberty in the Park almost from the beginning. The typical form breeds freely and in spite of the many drawbacks inherent in a public park, maintains itself well. Some years ago we settled a fine cock of the black-shouldered variety, which is considered to be a dark mutant of the ordinary bird. This form is dominant in character, so that when it is crossed with the parent type, black-shouldered young result.

Another flock that has increased without hindrance or inconvenience is composed of African love-birds, inhabiting the middle cage in the Large Bird House. There are seven species of Love-birds in this cage, some of which keep



Peachicks are frequently hatched in the Park and this picture shows an Indian hen with three that she reared. The young male near the center is already exercising his almost nonexistent "train" by raising its feathers in display posture. Chicks are able to fly within a few days after hatching.

strictly to themselves. But four of them—Fischer's (*Agapornis fischeri*), the masked (*A. personata*), the Nyassa (*A. lilianae*) and the black-cheeked (*A. nigrigenis*)—have interbred with such abandon that they have become a complete hodge-podge. Curiously, the black mask, yellow breast and yellow collar of the masked seem slowly to be getting the upper hand, though the brick-red faces of Fischer's and the little Nyassa still sometimes reappear to point the bar sinister.

Even though conditions may be unfavorable, we still take advantage of any unusual opportunity to attempt rearing something really worth while. Such good fortune came to us this year, when a female Argus pheasant scooped a shallow nest in the sand in a corner of her run at the Pheasant Aviary, and laid the normal clutch of two eggs. The position was most unsuitable, since it was fully exposed to both sun and rain. With some misgiving, an open hutch was built of boards and gently placed over the brooding

bird. We half expected her to desert her eggs in indignation, since birds almost invariably resent any interference with their nesting sites. However, the Argus acted as though she might have erected the shelter herself, so complete was her acceptance. There was still danger that the dry sand might affect the moisture content of the eggs but this was avoided by damping the sand.

Such complicated efforts are not always crowned with success but on July 31 a chick emerged from one of our eggs. Since incubation began on July 7, a period of twenty-four days was established. More than three months have passed at the time of writing and in spite of great activity at the Pheasant Aviary, by painters and sandchangers, the chick has grown well. Should he live to reach an independent state, he will be the first of his kind to be reared in captivity in the East, north of Maryland. Maryland must be excepted, for Mr. C. F. Denley reared the Argus there in 1935 to establish the first American record east of California.

On the World's Greatest Fishing Grounds

Two Months in the Gulf of California and on Clarion Island Constituted the Templeton Crocker Expedition of the New York Zoological Society; the Twenty-fourth of the Department of Tropical Research

WILLIAM BEEBE

AN invitation from Templeton Crocker to accompany him on his yacht *Zaca* for a two months' expedition to the Gulf of California came at exactly the right time. The West Indian trip¹ ended on March 13, and by transporting ourselves and our equipment at once across the continent we were able, twelve days later, to connect at San Diego and steam out into the Pacific. We returned on May 25, after sixty days of as productive and satisfying field work as I have ever experienced. There were four of us from the Tropical Research Department: John Tee-Van, Jocelyn Crane, George Swanson and myself. The living and laboratory accommodations, the equipment for every kind of oceanographic work, the keenness and ability of the captain and crew, the freedom of choice of locality and duration of stay, and above all the intelligent interest and active co-operation of Mr. Crocker combined to make this an ideal experience.

The *Zaca* is a Diesel schooner, 118 feet over all, with a gross tonnage of 84. The greatest surprise to me was the boom-walk and the pulpit which had been recently added, modelled on those of the old *Arcturus*, and which were in constant use.

We made brief stops at Cedros Island and Magdalena Bay on the way down the Lower Californian coast. The most interesting thing about this particular region is the faunal line at the latitude of Cedros, where there is an admixture of types, marking a distinct change from the northern fauna to tropical organisms which became dominant at Cape San Lucas. Even the giant kelp dies out a few miles to the southward, together with all the animal life to which it affords shelter or for which it provides a home.

From here we concentrated on three distinct

regions, first, Cape San Lucas together with the neighboring banks of Gorda and Arena; second, Inez Bay half way up the west coast of the Gulf of California; and third, Clarion Island, 600 miles out in the Pacific, well south of San Lucas and the most westerly of the Revilla Gigedo group. The variety of experience and the richness of the results of this expedition can be treated adequately only in a volume, which is well under way. In this article I can touch only on some of the high lights of Inez and San Lucas, leaving the wonderful island of Clarion for another time.

Superlatives are the last resort of feeble diction. Nevertheless I cannot resist the statement that the waters about San Lucas and the Gulf are a paradise for game fishermen and for the oceanographic scientist. At the very tip of Lower California are those majestic rocks, Los Frailes—The Gray Friars—which form the background for the great sailfish group in the American Museum. Just outside these an amazing variety of gamefish make their home. As a sample of one hour's fishing on April 25, we went out after a very rare, recently named yellowtail (*Seriola colburni*) of which we had already taken one specimen. We caught instead 48 great, gold-spotted sierra mackerel, of which we saved 14 for food and study and threw back all the rest unharmed. Here giant groupers of fifty pounds and more would rush our jigs and struggle until we were ready to give in before the fish. On other days schools of bonitos, like silver spindles, would fight for the lure, and now and then sailfish and marlin leaped high into the air. Coached by Templeton Crocker I landed a 207 pound striped marlin (*Makaira mitsukurii*) in 35 minutes, and even in the excitement of success I felt a twinge of pity for the magnificent creature. This was tempered when I marshalled all the facts of food, struc-

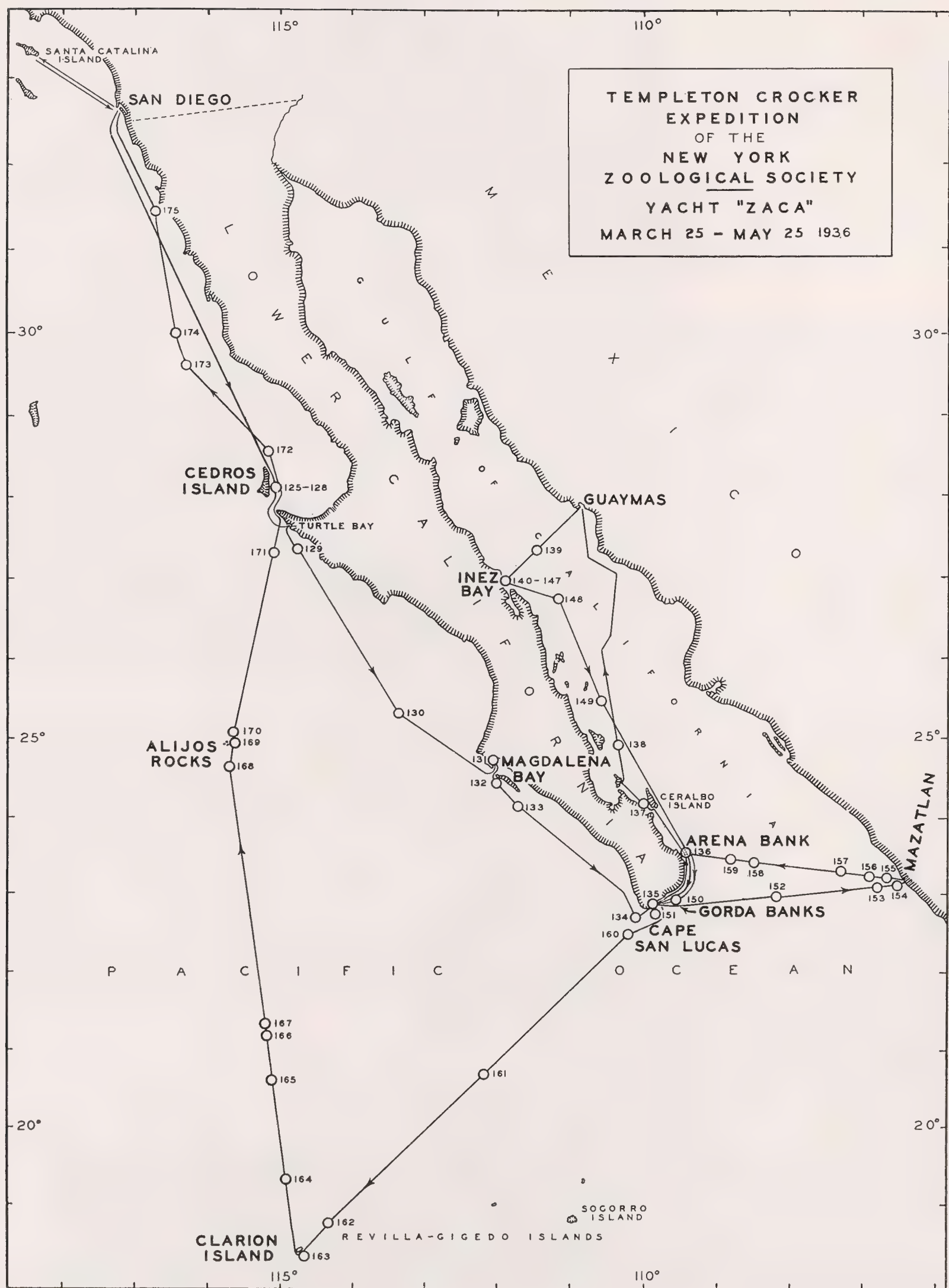
¹ Bull. N. Y. Zool. Soc., July-August, 1936.

Templeton Crocker's Zaca was the comfortable home of the Zoological Society's expedition for two months.



(Left). The vegetation of Lower California is weird and unreal, adapted, like this giant cactus, for a desert existence with a minimum supply of water. (Below). The Gray Friars of sculptured granite form the very tip of Lower California. These rocks are the home of sea-lions, cormorants, ospreys and ravens, and there is wonderful fishing in the neighboring waters.





ture and parasites. The serpent in this fishing Eden was a yacht we passed, which shall be nameless, whose occupants had captured, or shall we say massacred, 51 sail- and swordfish, put them on ice until there was no more room, then hung them around the bulwarks, photographed them and dumped them overboard.

We wanted to study the Pacific tuna as we had those of the West Indies, and here, ready to hand, far up at the very head of the Bay of San Lucas, we found a diminutive tuna can-

nery which provided us with all the data we needed, even to the number of 535 stomachs in a single day!

After a stay of three days at San Lucas, we went east a few miles to the two great banks off shore and spent a day of intensive trial dredging. The unbelievable richness of the hauls confirmed our intention of returning and making this one of our centers of research. On and up into the gulf we steamed with brief stops at Ceralbo and Espiritu Santo Islands

and then cut obliquely across to Guaymas on the main Mexican coast. We ploughed through a bad gale all the way, which on shore resolved itself into constant dust storms. Outside the city a palatial hotel, La Playa des Cortez, was just being completed, a hostelry intended to attract game fishermen from the States. With laundry, and with oil for the Diesels out of the way, we set forth again, this time on a sea like a mirror.

We set our course due west across the Gulf, making a number of 500-fathom hauls on the way. Early on April 9 we steamed in toward Inez Bay, passing on the way the two small islands Inez Major and Minor. The Doctor kept busy pulling in the feather jig, skipjacks succeeding great cero mackerel. Scaup ducks had to flip helplessly along the surface and finally dive out of our path, for there was not a breath of air to lift them; boobies went past in twos and threes, and cormorants in endless lines

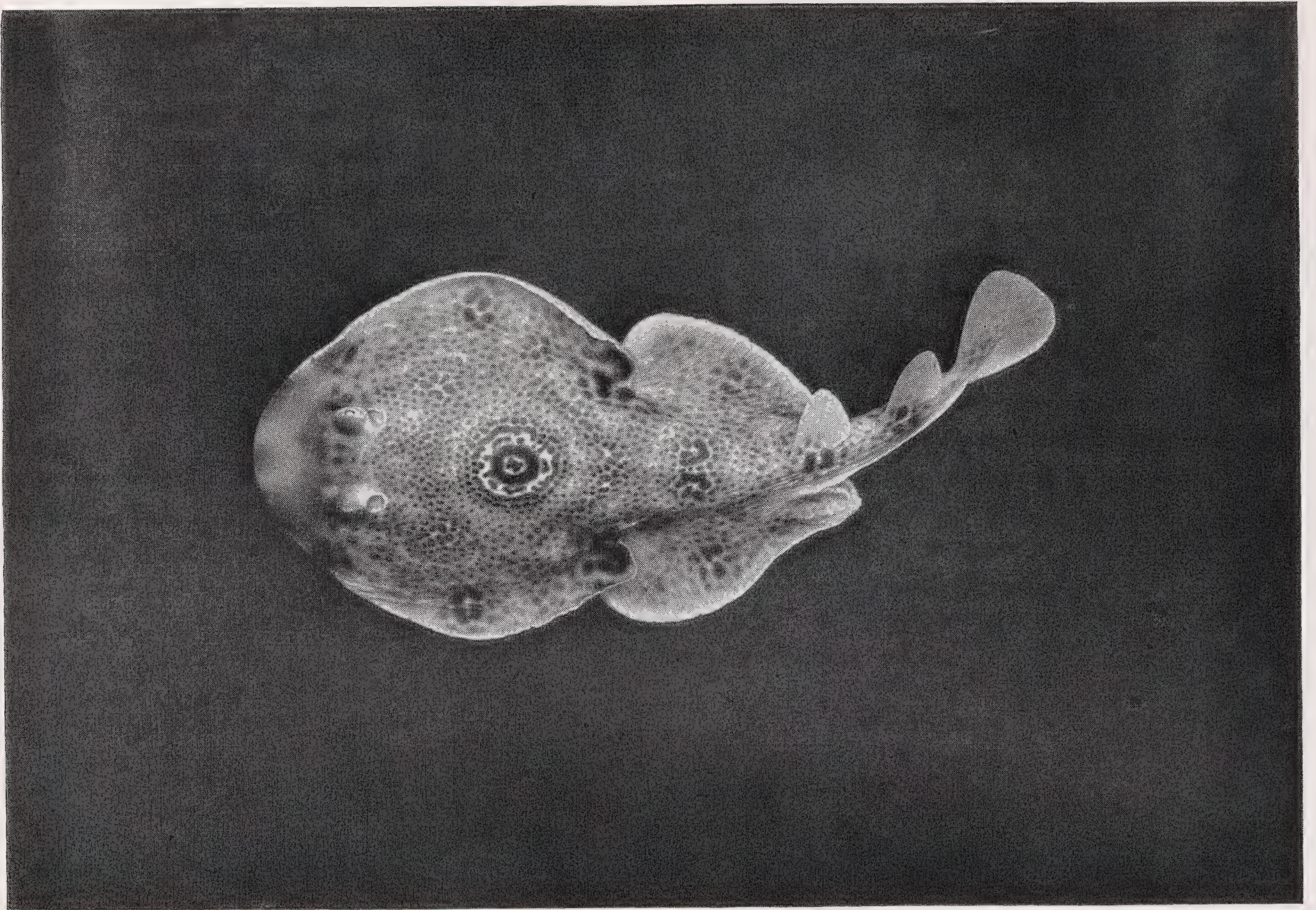
of thousands; pelicans dived like swift plummetts and when they emerged, little black-headed gulls alighted on their heads and took toll of the small fish oozing from the beaks of the great birds. As the anchor went down a gorgeous triggerfish came up on the line of our indefatigable Walton, and a six-foot hammerhead shark circled round the *Zaca*.

We had reached our first field station and for the succeeding eight days we gave our energies and all five senses full play in the discovery and interpretation of the life, and especially of the fishes, of this region. By April 17 when we left, we had recorded 122 species of fish and a host of ecological notes, and made detailed studies of the results of trawls and dredges from the surface to a depth of 50 fathoms.

The time we spent at Inez was, in some ways, the most unreal week I have ever had. This was due chiefly to the difficulty of realizing we were out of doors. What the illusion of a plan-



The bow pulpit was large enough to hold two men. From it a dolphin was harpooned and many scientific treasures scooped up in hand nets. The boom-walk extended far out abeam, clear of the Zaca's wash, and was useful day and night.



These little rays (Discophyge ommata) lie on the bottom and defend themselves with considerable shocks of electricity produced in a pair of muscle batteries lying along the back. The fish can generate about 20 volts, sufficient to stun small creatures. They are beautifully colored as moths.

etarium does to our sensations of the heavens at night, Inez did to the daytime from horizon to horizon. After the almost continuous rough water and high winds of the early part of our trip, we had now a sea like glass and an atmosphere completely quiet. When we came up on deck we seemed only to be entering an enormous room. It was neither cold nor hot, no clouds moved, the only moving shadows were those of passing frigatebirds and vultures. And we were the only human beings in this strange world. Once we were visited by a quartet of Mexican turtles who came and went, swiftly and quietly; and once three Indians watched us from a distance in their canoe and then shattered the air with the most sinister yells I have ever heard, at the same time paddling madly northward. The surface film was never broken except by our boats, by alighting pelicans or leaping fish, or when I climbed down in my diving helmet.

When water-soaked from seining, or having dived until I shivered and shook even in this temperate water, I went ashore and walked inland over ground which had been thirsty since the dawn of creation. Along the shores streams of black lava, which had cooled uncounted centuries ago, alternated with beautiful bays of white sand. The upper parts of these beaches were almost pure cultures of shells; elongate white trumpets, conchs and murex stained with pastel yellows and pinks, tall ebony mitres, olive shells and cowries with colors and patterns which recalled the stained glass and chisel-work of medieval cathedrals. There were also purple and wine-colored scallops, and cones of richest rose ruled with parallel black lines like a scroll prepared for musical notation. The wealth and beauty of these lovely things were rather those of an imaginative page of "Swiss Family Robinson" than an actual tropical beach. In one little cove we found hundreds of tall



(Upper). The great deep-sea dredge, after only ten minutes on the bottom at a depth of 300 feet, comes up filled with more than 25,000 serpent starfish. (Lower). Another dredge haul contains only *munidas*, hundreds of long-armed, scarlet crustaceans, looking like some alien form of diminutive lobster.

spires or minarets, no two of which were alike. We collected many of these empty shells near or in the shallow water and later on deck they developed unexpected activity. Most of them were inhabited by hermit crabs, while from others emerged small octopi, white-handed crabs, and blennies of amazing beauty—emerald, azure and orange with tall, banner-like dorsal fins.

When I climbed the first ridge above the beaches, I could look out over the surface of the great bay with the *Zaca* like a tiny chip floating in the distance, and down among the rocks and weed beneath me I could clearly make out the hosts of fish. Turning in the opposite direction, I saw only eroded hills, rising gradually into ranges of mountains, some of which reached up a mile into the blue sky. Everything in this half of my horizon was parched and dry, the slopes and gullies covered

with a sparse scattering of desert plants, giant cacti and lowly, dusty shrubs, all fashioned to absorb and conserve every possible drop of dew for very life's sake. Gray hummingbirds balanced close to my face, sand-colored lizards scurried from underfoot and long-eared jack rabbits lolloped slowly away as I approached. Huge croaking ravens and silent circling vultures came down for a look at me, calculating, like feathered insurance accountants, the chances of my prospective decease.

The deeper waters of the bay were much colder than the surface and we could spend only a few minutes at a time below five fathoms. Yet every dive showed new things of interest. I suffered as only Arctic explorers can, trying to get close enough to a trio of golden groupers to kill one with a dynamite cap. Many other species, such as scorpionfish, were easily stalked and killed. I had to be careful in re-



For a week the expedition explored the lovely bay of Santa Inez, half-way up the Gulf of California. Ancient lava flows and white sandy beaches bounded the blue waters which swarmed with fish and strange creatures of many kinds.

trieving these latter, for the first prick from one of their fin spines taught me what an efficient protection their poison glands must be.

One day I went down from the *Zaca's* anchorage in 32 feet of water to salvage an outboard motor dropped overboard by accident. After sending up the motor, I walked about in the dim, moonlight gloom and saw fields of tall graceful seapens waving like some strange grain, while scattered about their bases were giant scarlet starfish. Before ascending I picked up a large spindle shell and in the sunlight above found that the inmate was sheer turquoise and rose.

The sunsets were always of infinite beauty. The deep cloudless blue of the sky would change gradually to gold, yellow and orange over the distant ranges of mountains, which vanished at last in purple and lavender. These were more nearly like under-water reef colors than any I have ever seen. When the darkness closed down, the quiet was as unbroken as in the day, the only sound being the breathing sighs of porpoises and seals.

The nights were moonless, which was excellent for our fishing. Mr. Crocker had among his crew two splendid Samoans, Frank Taiga and Pemasa Utu, to whom the water was an element as familiar as the land and the air. We discovered a whole new world of life in night spearing. Holding the powerful flashlight, I would crouch low in the bow of a boat while Frank stood over me like a Colossus of Rhodes with poised spear. We would then be silently sculled through the dense growth of sargassum weed near shore. Octopi, so large and powerful that their capture taxed all of the Samoan's great strength, yard-long groupers asleep upon their sides, rays, skates and moray eels slithering along the bottom—all showed as clearly as if we were poised in mid-air above them. One of the rays, decorated with a bright ocellus in the middle of the back, startled us with several electric shocks when brought over the side. Night after night, in exactly the same spot we would float over hundreds of large puffers sound asleep on the bottom, each covered with a scanty sheet of sand, while scarlet apogons and angelfish swam in and out among the weed, seeming never to sleep. These and many others provided us with specimens and with a new

knowledge and appreciation of the conditions of nocturnal fish life.

We were able during our brief week at Inez to unravel some of the intricate relationships of animal life, especially through distribution and food. High up in the heavens vultures and frigatebirds kept watch, while ospreys, boobies, gulls and petrels fed from the surface, and grebes and cormorants dived to the very bottom. Even if we had never seen a frigate rob one of the divers we would have guessed it when we took a large flounder from a frigatebird's stomach. Flyingfish broke forth into the air and batfish and rays hugged the bottom, while scores of other species swam and fed and lived between. We tabulated all these, together with the crabs, mollusks and urchins, from the shallows of the shore down to fifty fathoms. Our present task in the laboratory in the Zoological Park is to sort, name, discover enemies, food, breeding seasons and the disguises of youth, and in this way to envisage the populations of the invisible world existing beneath the zone of the diving helmet.

We left Inez with infinite regret on April 17 and throughout this and the following day worked slowly southward, trawling, dredging and using the boom-walk for night-light work. Four days were spent in running a line of deep-sea stations across the mouth of the Gulf of California to Mazatlan, but with this exception we devoted the time between April 19 and May 7 to Cape San Lucas and the adjacent Banks of Arena and Gorda. The difference in the living creatures in this area from those of Inez Bay, 275 miles to the north, was very evident.

We worked the beaches and shallows, dredged in 2 to 20 fathoms from a motorboat, and made large hauls on the banks, from the *Zaca*, in 35 to 120 fathoms. In all we completed 92 dredges, the exact locality of each haul being carefully computed by land sights. We trapped and trawled and collected at night as well as day, and feel that the 170-odd species of fish which rewarded our efforts are a representative lot. The crabs are the only group of invertebrates which have thus far been worked up and Miss Crane finds that in this San Lucas region alone we collected 60 species, of which 8 are new to science.

Our method on the banks was to dredge al-



Templeton Crocker looks on while a 207-pound marlin is being weighed, preparatory to being studied and dissected. These and sailfish are common in the waters about San Lucas.

most continuously throughout the day, as fast as the hauls could be made, controlled only by the time required to sort the material and to record roughly the evanescent colors. At sunset we would steam slowly toward shore and anchor in about fifteen fathoms for the night, within range of the faint, pungent scent of desert foliage and of the deep booming of breakers on the shore. Here we would reap a rich harvest of the multitude of sea creatures attracted by our submerged lights. We found that at night many young fish left their homes among the coral and weed and traveled to the surface. Infant butterflyfish, triggers, mullets, puffers, wrasse, trumpetfish and scorpionfish came to the light together with such pro-

nounced bottom livers as clingfish and blennies. When larger fish arrived, schools of sinister squid materialized simultaneously and cruised about the outer penumbra of illumination, taking heavy toll. Once at midnight I was awakened to see a giant barracuda which had taken one of our hooks.

One of the most interesting and unexpected results of the dredging was the concentration of some one species of organism in certain localized spots. A ten-minute haul brought up 25,000 serpent starfish, and the very next dredge made in the same direction and only a short distance away contained a mighty mass of mud which, when washed clean, held not a single starfish but instead, hundreds of scarlet munida crustaceans. Again, a netful of several species of flounders would come into sight and the next haul show not one. In one net there were 388 small box crabs, in another 97 large, rare collector shells, and so on. We cannot explain this, for we have nothing with which to compare it in shallow water or on land. The bottom life two hundred feet down on these banks

must be as strange as any imagination can picture.

One joy of expeditions such as this lies in the variety and unexpectedness of experiences. For days we had been seeing very large fins of sharks, placed far apart, cutting the water about this tip of Lower California, and had put them down as giant blues or hammerheads, or perhaps marlin larger than any which have ever been caught.

On May 2 when we had pulled up the last dredge on Arena and were headed southward toward Gorda we once again sighted an immense fin off the port bow with a second fin so far behind that it seemed as if two or even three sharks must intervene. The *Zaca* held on her course but the wandering fins gained and finally turned toward us and passed close. I was several yards up the ratlines and as I looked down, I saw the water suddenly filled with a multitudinous pattern of white spots—a single gigantic whale shark, largest of all fish and rarest of sharks, was swimming slowly past.

The fish was visible until we lowered the launch and started out. For ten minutes thereafter no sign was seen of him, then the fins appeared a hundred yards away and we headed toward them at full speed. Ben was at the engine and Frank Taiga and Pemasa, the two Samoans, had a mighty harpoon fastened by a long rope to an empty gasoline drum. When we came alongside the fish was only about three feet beneath the surface. We waited until he was almost awash, when both men made a most beautiful pole-vaulting dive, with the harpoon between them. They struck hard and then leaped into the air and let their whole weight bear down, driving the harpoon home. At the same moment I fired a revolver straight down into the creature's head and made two direct hits. The drum was thrown overboard and vanished. After fifteen minutes excited yells came from the crew on the yacht and they directed our attention to the farther side, and there, three hundred yards away was the float. We found it all crumpled up in the middle, like a huge hour-glass, evidence of the pressure at the great depth to which it must have been subjected. It was moving slowly and steadily ahead.

We soon caught up with it and for the next hour had the excitement of our lives. The great creature was never more than fifteen feet down

and usually within a yard of the surface. Twice we had chances to put in an additional harpoon but the iron bent as if it had struck steel. Pemasa said this often happened in the case of large sharks. The first harpoon entered easily but after that the tightening of the dermal muscles made it impossible to drive through. We tried to slip a cable over the drum and around the tail but the speed, slow though it was, prevented this. Off and on for long periods of time I watched the shark, trying to memorize every spot and pattern. There seemed to be no end in sight, for we were like helpless midgets in our inability to do further harm to this giant. His steady progress seemed to indicate that he could go on like this for days or weeks! We tightened the noose around the drum and led the cable back to the *Zaca* where it was made fast, whereupon the whale shark headed steadily alongside. The moment he felt the pull of the yacht he tore out the harpoon as if it had been a pin, and started for the open Pacific.

I estimated his length at 35 feet, but the splendid photograph which John Tee-Van took from the cross-trees, permitted direct comparison with the known length of the motorboat, and proved the shark to be 42 feet long.

We found that in this fisherman's paradise these whale sharks (*Rhineodon typus*) were almost common, and the Japanese captain of a tunaboat told me that he often saw ten in the course of a day. On May 3 John Tee-Van, Jocelyn Crane and I followed one for two hours, most of the time just overhead or close alongside. By racing our engines we were able to disturb him sufficiently to herd him into patches of slick calm, where we could photograph and observe as through clear air. Several months later I took these photographs to the British Museum where they were of use in helping with the construction of a whale shark model, and later the same thing was repeated at our American Museum.

The upper surface of the pectoral fins and the whole head from these fins forward were very thickly covered with two-inch white or creamy spots in dense irregular disorder. From here aft the spots became abruptly larger and farther apart, in regular rows separated by white vertical lines as far as the second dorsal fin where they gradually disappeared. There was no sign of horizontal white lines nor of lateral



A whale shark 42 feet long and weighing at least 8 tons was harpooned by the two Samoans.

dermal ridges. From every aspect the entire surface appeared perfectly smooth. The head was exceedingly blunt and broad with the mouth full six feet across. The teeth in this huge mouth were arranged in great sheets, consisting of thousands upon thousands of teeth each about an eighth of an inch in length. The tail fin was enormous and swept regularly back and forth like some part of a mighty engine. The tip of the fin swung from one side to the other in three seconds of time and through a space of ten feet. The strangest thing was the result of the identity of the shark's general color with

that of the sea water. When we came within sight of the creature the outline was so indistinct that, as I have already said, the effect was of the water being suddenly filled with a vast number of unconnected, drifting spots of white.

In the last dredge at Arena before we recognized and harpooned the whale shark we brought up four *Amphioxus*—inchling relics of the very origin of fish life on our planet. An hour later we were impotently struggling with eight tons of the most specialized shark living today. A greater contrast would be difficult to imagine.

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NOTES FROM THE ZOOLOGICAL PARK AND THE AQUARIUM

"Hornaday's Polynemus"

In a paper published in the *Journal of the Washington Academy of Sciences*, Vol. 26, No. 9, Dr. George S. Myers describes and names in honor of Dr. William T. Hornaday a new species of fish collected by Dr. Hornaday many years ago. Dr. Myers gives the species the name of *Polynemus hornadayi* and says in his paper:

"Fifty-nine years ago, William T. Hornaday, now the honored director-emeritus of the New York Zoological Park, travelled in India, the Malay Peninsula, and Borneo to collect natural history specimens for Ward's Natural History Establishment of Rochester. His book dealing with that trip, *Two Years in the Jungle* (New York, 1885), is now one of the classics of zoological exploration in Asia. The fishes collected by Dr. Hornaday became the property of the United States National Museum, in which institution he remained for several years as chief taxidermist. Some of the fishes were identified by Dr. Tarleton Bean and the rest have recently been determined by the present writer. One species, a remarkable *Polynemus*, appears to be unnamed more than half a century after its collection."

It was that previously unnamed species that Dr. Myers described and named for Dr. Hornaday.

Another "Man-eater"

The capture of a "man-eater" shark, *Carcharodon carcharias* (Linn.), not very much under the record for size, was reported in the July-August *Bulletin*. Since then another has come to light,

which more closely approaches the record. Unlike the previous one, this fish was captured with rod and reel after a struggle which lasted five and one-half hours.

The shark was taken by Dr. Walter M. Hamilton of Roselle Park, New Jersey, while fishing in St. Margaret's Bay, Nova Scotia, on August 19, 1936, and we have at hand an affidavit made out by Lionel Boutilier, signed by Justice of the Peace, Mr. Ellison Shatford, covering the following data:

58 pounds and exceeds it by a length of 2 inches.

Length over all 12 feet 2 inches; weight 940 pounds, on scales certified by the Dominion Government Fishery Inspector. The record fish measured 12 feet and weighed 998 pounds.¹ The Since anglers customarily gauge their catches by weight, the 998 pound record still stands, but with the increasing activity of sea anglers it may be expected to fall at any time.—C. M. B., Jr.

¹ From *World's Record Fish*. Van Campen Heilner, Ray Schrenkeisen and Francesca R. La Monte. *Field and Stream*, February, 1936, p. 26-27.

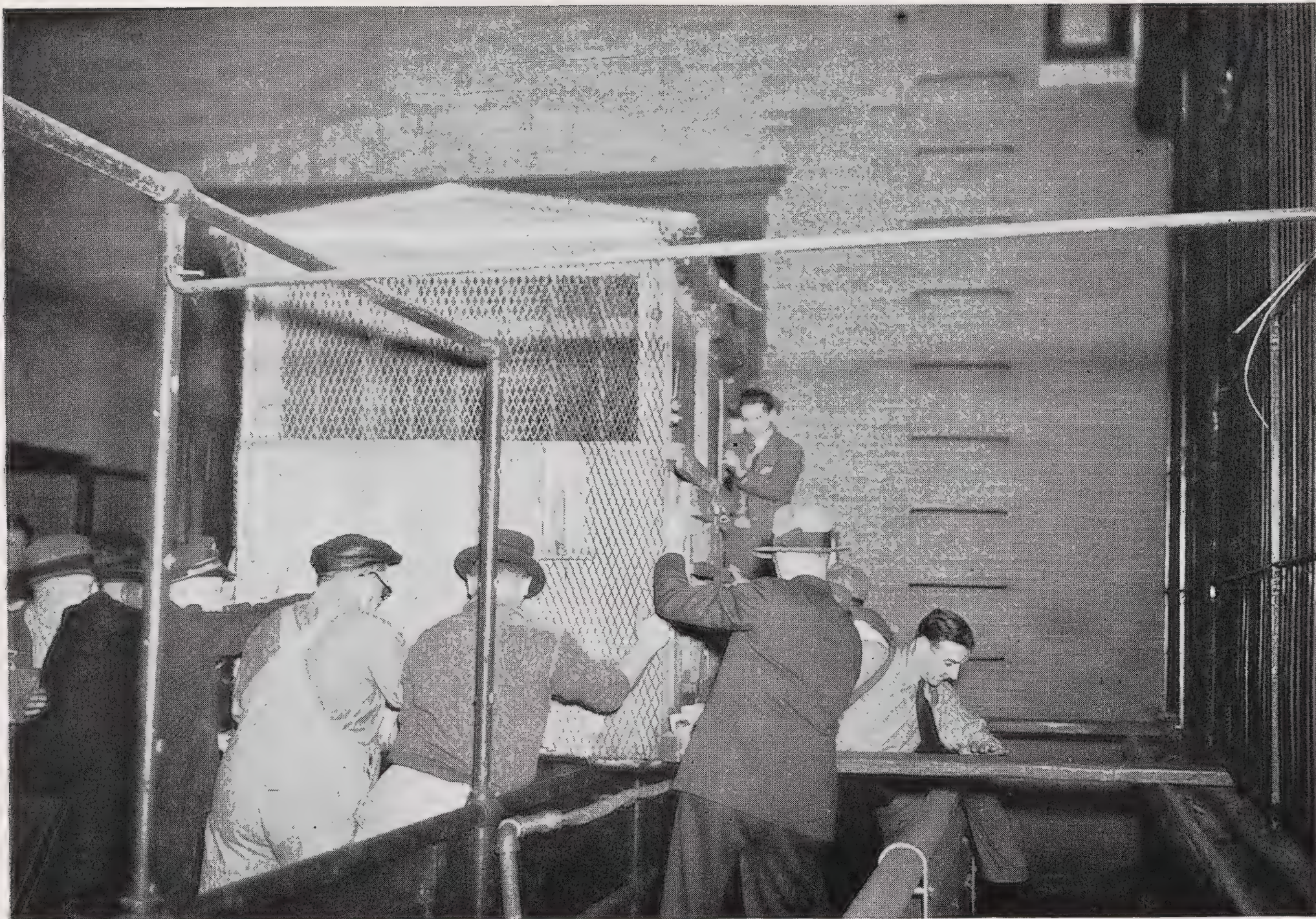
The Smallest Monkey

A specimen of the pigmy marmoset, *Callithrix pygmaeus*, the smallest monkey in the world, was acquired by the Zoological Park this fall and was placed on exhibition in the Reptile House where it could share sunny quarters with another interesting monkey, the lion marmoset.

The newcomer is of true pigmy proportions, although its comparatively large teeth indicate that it is fully adult. So small that its whole



Four ounces of monkey is not much—except for its long tail, the pigmy marmoset is not even a good handful.



Handling the orang's heavy teakwood traveling cage after it was delivered to the Zoological Park was the hardest part of the job of transferring the animal to a safe cage in the Primate House. A dozen men panted and tugged the box into place.

body can comfortably be encompassed in one hand, its weight is only four ounces.

Several authorities limit the pigmy marmoset to an area in western Brazil, but the Park's specimen was captured in Ecuador. Apparently no previous record exists for the animal's range in that region.

The marmoset was purchased from Dr. Wolfgang von Hagen, an explorer and collector. As far as is known, no other specimen is on exhibition in the United States,

A Big Orang "On Deposit"

"Truson," a magnificent adult orang-utan that probably exceeds in weight and size any orang now in captivity, has been placed "on deposit" in the Zoological Park by his captors, Mr. and Mrs. Martin Johnson. The animal occupies a tested, orang-proof cage in the Primate House and will be left there indefinitely.

The orang was captured in the jungle of North Borneo about seven months ago while the Johnsons, lecturers and camera-hunters, were there on an expedition to photograph animal life.

"Mrs. Johnson first saw the orang while she was fishing in a canal near our camp," Mr. Johnson said. "'Truson' is the native name for a canal, and that is why we gave him that name.

"Our camp was in orang country and there

were plenty of them around, but we didn't suspect the presence of such a big one until Mrs. Johnson saw him in the top of a tree, shaking it and throwing branches in her direction.

"She ran to call me and we decided to capture the animal, if we could. It was obviously a job that was going to take a good deal of help, so I sent out a call for natives and managed to round up several hundred of them.

"First we cut down all the trees in the immediate vicinity of the tall one where the ape was perched, so we would have a clear place to work when we brought him down. After the clearing was out of the way, we rigged up a kind of trap—a noose, or lasso, on a frame. We baited it with fruit and hoisted it up within reach of the orang.

"He was not unduly suspicious and finally put a hand in the trap to seize the fruit. It was arranged so the noose could be tightened by a tug from the ground, and in that way we caught his arm and then all we had to do was to keep on pulling until he came down to the ground. We had stout nets ready for him—some I had had made before we left New York. They were the kind of nets the fire department uses for rescue work.

"I had between two hundred and three hundred natives waiting to use the nets and tangle him in them so we could get him into a cage, and it



Photo copyright by Martin Johnson

Truson's tremendous reach of arm and the length and thickness of his red hair are indicated in this photograph taken by Mr. Johnson in the temporary quarters the orang occupied in Borneo. Great cheek-pads frame the animal's tiny, close-set eyes.

took the combined efforts of all of them to do the trick. Even so, seven men were hurt and had to go to the hospital at Sandaken, and a good many more were scratched and bruised.

"After we finally got him in a cage there was no more trouble. I had a heavy teak traveling cage built by Chinese carpenters and there wasn't the slightest chance of him getting out of it. We took him by junk to Sandakan and on to Singapore from there by steamer."

Mr. Johnson fed the ape on a choice collection of fruits that were easily available in the tropics but proved to be somewhat more expensive when he reached northern latitudes. Bananas, apples, melons, oranges and bread form the staple of the orang's diet.

The collector believes that Truson is the largest orang ever captured. Animal collectors seldom tackle a large and fully adult orang; the usual practice is to go after an immature specimen that can be more easily handled and transported. Some orangs thus captured have attained immense size in captivity, although they were probably little, if any, larger than Truson. His weight is variously estimated from 200 to 300 pounds, but the thickness and length of his red hair gives a deceptive impression of size. The animal's tremendous reach, fully seven feet when both arms are outstretched, is undeniably gigantic.

New Bird Rarities

In these times of scarcity of desirable birds for addition to our collection, almost any arrival, aside from common species, is notable. But when we receive a shipment such as that brought to us from France by M. Jean Delacour on October 7, it is worthy of special note. M. Delacour is one of the world's leading aviculturists and when he sent us a list of unusual birds available in Europe, it was to be expected that it would contain many rarities. Not all would suit our accommodations but we eventually selected a number that we could conveniently find room for. Some of them we must have taken, even had there been no room.

When M. Delacour, accompanied by M. Edouard Edmond-Blanc, finally arrived on the S.S. *Ile de France*, we found the birds in excellent condition. All but three of the species were new to us and even these were missing from our collection at the time. Most important is a lovely male Gray-chested Bird of Paradise (*Paradisaea decora*) from Fergusson and Normanby Islands off the southeastern tip of New Guinea. This bird had never been seen in captivity until a small number were landed in England in the spring of this year. In general, it is like a very pale Lesser Bird of Paradise, but the filmy flank plumes are bright red instead of yellow. There is a fine adult male New Guinea Rifle Bird (*Craspedo-*



Whether it be a new species or simply an unexplained abnormality, the "camel-backed turtle" from Hainan island is a curiosity that has attracted constant attention from visitors to the Reptile House where it occupies a glass-sided tank.

phora magnifica intercedens) and a pair of Comri's Manucodes (*Manucodia comrii*), the latter hailing from Fergusson and Normanby. This is the largest of the manucodes, as large as a crow but far more beautiful. This addition of three species of birds of paradise brings our present total up to fifteen.

A Javan Cissa or Hunting Crow (*Cissa thalassina*) is a red-billed bird with delicate yellow-green plumage, while the Blue-tailed Pittas (*Eucichla cyanura*), also coming from Java, depend for their beauty on sharp contrasts of green, blue and yellow. There are three kinds of tiny, gaudily marked waxbills from Africa, none of them previously seen in America. These are the Black-headed Waxbill (*Estrilda atricapilla*), the Black-capped Waxbill (*Estrilda nonnula*) and the Blue-breasted Grenadier Waxbill (*Granatina ianthinogaster*). Perhaps the most brilliantly colored of all are two Purple Carib Hummingbirds (*Eulampis jugularis*) from the West Indies. Very much larger than our native Ruby-throat, these graceful birds are a blazing garnet red, with emerald wings. More vigorous than the smaller species, they have been placed in a large, glass-fronted cage, along with our sun-birds and sugar-birds.

As the gift of M. Delacour, we have a pair of Rheinhardt's Argus Pheasants (*Rheinhardtius ocellatus*), a magnificent species quite new to us. To the beauty of the Common Argus, this bird adds a tufted head, red beak and an even greater length of the main tail feathers. Also as a gift of M. Delacour, there are two kinds of the smaller African hornbills: the Crested Hornbill (*Lophoceros melanoleucus*) and Hemprich's Horn-

bill (*L. hemprichii*). Both have been seen here before but were not represented in our collection at the time.

"Camel-back Turtle"

One of the most curious turtles the Zoological Park has ever exhibited is the so-called "camel-back turtle" of purely aquatic habits that has been on exhibition in the Reptile House since it was acquired from J. Linsley Gressitt of the University of California. According to the collector it is an abnormal form of *Amyda steindachneri*, a very rare turtle occurring in Hainan and West China.

The turtle was first offered to the park some months ago after Mr. Gressitt's return from a collecting trip to Hainan Island off the coast of China, and was the larger of two specimens he discovered there. Mr. Gressitt wrote that he believed it to represent a new species, a new genus, and at least a new subfamily of soft-shelled turtles. About one foot long exclusive of the neck, broad and deep, weighing about ten pounds and with a steep, rounded hump on its back, the creature presented a striking appearance that was quite unlike any turtle previously exhibited here.

Mr. Gressitt's letter describing the turtle was soon followed, however, by further word that careful study had convinced him that it was a monstrosity, rather than a new form. "However, I cannot explain the cause of the condition, since it apparently occurs frequently in the species," he wrote. "I heard of one or two more individuals in the island, besides the two which I purchased."



A story in two pictures: red deer in a struggle for supremacy—and the victor's open-mouthed bugle of triumph. The battle starts when the stags charge each other with antlers lowered. In the upper picture they are shoving vigorously, and in the lower the defeated stag can be seen in the background, running away.

PUBLICATIONS OF INTEREST

THE MAMMALS AND LIFE ZONES OF OREGON. By Vernon Bailey. North American Fauna No. 55. U. S. Department of Agriculture, Washington, D. C., June, 1936. 416 pages, illustrated by maps and photographs. Superintendent of Documents, 75 cents.

The latest and best work on North American mammals that has come to our attention during the past year is Vernon Bailey's "The Mammals and Life Zones of Oregon," No. 55 of that well known series entitled "North American Fauna."

Previous to the appearance of the present volume Bailey contributed no less than five other numbers to the series, practically all of them being in the nature of reports and conclusions concerning the habits and distribution of North American wild life species, and founded to a large extent upon his studies and collections made in the field as Biologist for the United States Bureau of Biological Survey. Until his retirement about two years ago he was the dean of American field naturalists and the last of the old school to be in active service.

The introduction gives a complete and authoritative discussion of the life zone areas and physiographic features of the state of Oregon and their relation to animal life. The illustrations include a colored map showing the life zone areas and numerous photographs of typical zone localities. Through the body of the book are inserted appropriate photographs of the animals under discussion, mostly made in the field and supplied from the collections of the Biological Survey.

The systematic part of this book represents a good amount of hard, painstaking work. Some recently described races of western mammals included are:

Described

- 1932 *Bison bison oregonus* Bailey (extinct)
- 1932 *Antilocapra americana oregona* Bailey
- 1935 *Cervus canadensis nelsoni* Bailey (new name)
- 1932 *Odocoileus virginianus ochrourus* Bailey
- 1931 *Callospermophilus chrysodeirus connectans* Howell.

Each mammal species known to occur in the region receives full treatment. As a sample, opening the book at random, pages 308-309, we find an admirable discussion of the California skunk. The headings, which are followed, in order, for other discussions are: name, type, general characters, measurements, distribution, and habitat, breeding habits, food habits and economic status.

The result is a generally interesting and thoroughly reliable picture of the animal in question. The vast experience of the author is apparent throughout. Few can tell a better story and one so well founded upon fact. In this particular life history discussion we are reminded that the skunk is an excellent marksman and can fire directly to the rear, to the right, to the left, up or down, or forward over either shoulder, with unerring accuracy. Also that he takes on all comers, regardless of class or weight, and with apparent calm and faith concerning mere eventualities, ac-

cepts the challenge of man or dog, bear, mountain lion, or railroad train.

Bailey's latest book will be indispensable to all those interested in North American Mammals. —C.W.L.

FURTHER NOTES ON THE DURATION OF LIFE IN ANIMALS. II. AMPHIBIANS. By Major Stanley Smyth Flower. Proceedings of the Zoological Society of London, Part 2, 1936.

In the *Proceedings of the Zoological Society of London*, under this year's publication date of July 20, is a particularly interesting article by Major Stanley Smyth Flower relative to the duration of life of captive amphibians.

Major Flower explains that the object of this paper is to bring up to date the information contained in a former paper (Flower, 1925).

The listing of the records is by families. In comparing the records of widely separated institutions with the best facilities for maintaining and studying amphibians, there is remarkable similarity in the longevity of various unrelated species.

Of the tailed amphibians, there are records of the American siren living close to nine years, and an exceptional specimen 25 years. An European blind proteus lived close to eleven years. The average records of the American amphiuma, or mud eel, slightly surpass the former two species, with one record of 27 years. A specimen of the American hellbender, exhibited in Holland, surpassed all of these records by living in captivity for 28 years and seven months.

Evidently the large and strictly aquatic salamanders have the longest lives of any of the amphibians, this being illustrated by records of the imposing Japanese giant salamander which attains a length of close to five feet. Major Flower quotes a number of records on the species and says:

"The average life of twenty individuals, allowing a minimum number of years for attaining size-on-importation, is nearly 37 years. At least six individuals attained ages of between fifty and sixty years."

Of the small newts there are some surprising records. A specimen of the common European crested newt lived for seventeen years in captivity, a *Pleurodeles* newt for 19 years and six months, and a California newt was still, in its twenty-first year in captivity, capable of reproduction.

Of the American salamanders that transform to lead a terrestrial life are records of the spotted salamander, approximately 18 years, and of the tiger salamander, more than twenty-five years.

The records of even the smallest frogs and toads are surprisingly long. Specimens of the miniature European fire-bellied toad lived as long as 13 years, and a European natterjack toad 15 years. The tree frogs also carry long records of up to 16 years, being rivalled among the tailless amphibians by the similar record of an American bullfrog. Among other frogs with long records are the species of *Leptodactylus* of the American tropics. The longest record among these comes from a specimen in the New York Zoological Park, now on exhibition and a resident of the Park for more than 12 years.—R. L. D.

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*Figures in black type indicate that the reference is, or includes,
an illustration, diagram, or map.*

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SOCIETY



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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

Annual Membership in the Society is \$10, renewable annually. Life Membership may be obtained for \$200. A contributor of \$1,000 becomes a Patron; \$2,500 an Associate Founder; \$5,000 a Founder; \$10,000 a Founder in Perpetuity, and \$25,000 a Benefactor.

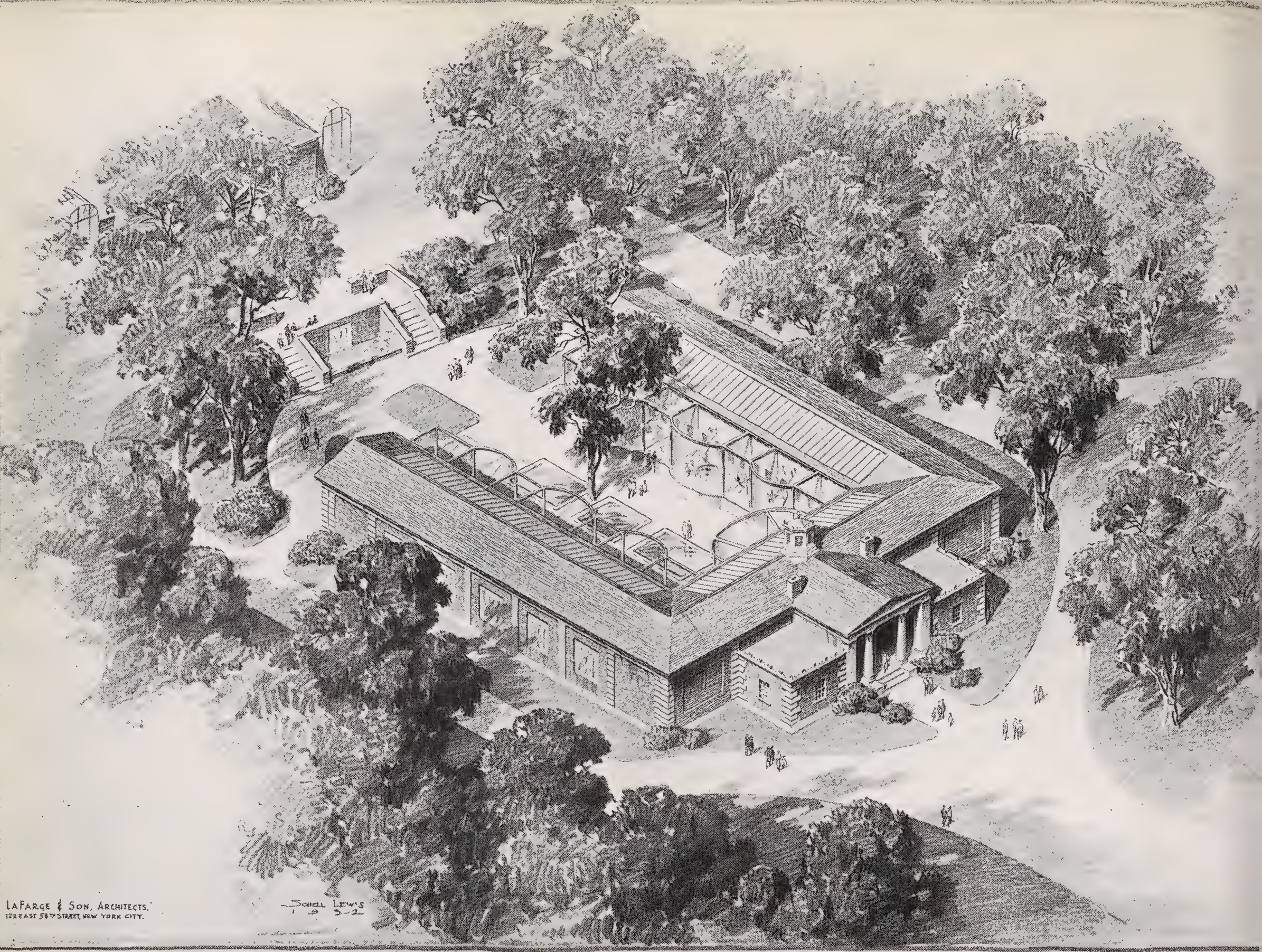
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Application for Membership may be given to the Director of the Zoological

Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 101 Park Avenue, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



PROPOSED NEW BIRD HOUSE
New York Zoological Park

BULLETIN

NEW YORK ZOOLOGICAL SOCIETY

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January-February, 1937

No. 1

A New Bird House for the Zoological Park

Overcrowding in the Present Structure Is Limiting Development of a Great Collection and More Room Is Seriously Needed

W. REID BLAIR

JUST before the end of the past year I presented an extensive program of new building for the Zoological Park to the Society's Trustees. The cordial and active interest with which that program was received, and the assurances given me that the time is at hand when we may plan for the near future with some confidence that plans will become realities, lead me to a decision to acquaint the members of the Society with the major items of proposed construction.

The program which I outlined to the Trustees, and which I propose to develop in detail in subsequent numbers of the BULLETIN, is the result of several years' close study of public demands upon the Zoological Park as an educational center, of further development in harmony with the magnificent plan laid down by the founders, and of recent improved practices in building for the comfort and better display of animals. In the main it is a program of permanent structures for exhibition purposes, although a certain amount of remodeling and repair work on existing buildings is imperatively needed and can hardly be delayed without costly deterioration.

The overcrowding of the present Bird House has been a source of concern for several years and the need for a new Bird House that will relieve the congestion has become so pressing that architects' sketches, based on our peculiar needs and upon recent developments in this specialized type of architecture, have been pre-

pared. They are presented herewith and, while many details remain to be worked out, the general form of the proposed building is clear.

Under the active supervision of Curator Crandall, our bird collection has become one of the finest, if not the finest, in the world. In variety of species, in rarities constantly on exhibition, it can hardly be rivaled on either side of the Atlantic. At the end of 1936 the whole bird collection in the Park contained 1,730 specimens of 730 species—and of these, 1,094 specimens of 534 species were housed in the main Bird House.

The result is a definite overcrowding for satisfactory exhibition and study, and a no less positive limitation of future development. Many birds that are available on the market cannot be kept because their space requirements are too high, some because they are comparatively large birds that must have roomy cages for comfort and others because their quarrelsome disposition makes it impracticable to house them except separately or in amicable pairs.

Casting about for a satisfactory solution of a situation that has long been serious, the conclusion was reached that several groups of larger birds now exhibited in the Bird House should be removed to new quarters and the present building turned over wholly to the smaller perching birds, which thereby would be afforded really satisfactory exhibition. At present not only are many small perching birds virtually hidden from the public, but their

FEB 4 1937

lovely song is lost in the cacophony of the noisier inmates of the house, such as the parrots and macaws.

It is proposed in the new building to house not only the noisier birds, but also those that suffer in their exhibition value by their present method of confinement.

At the beginning of 1937, 70 species of the parrot family were on exhibition. What the future may bring in the way of additions to the group is uncertain, although it is probable that enough species will always be available to make a most attractive display. The psittacosis alarm of a few years ago caused such restrictions on the importation of all members of the family that fewer wild parrots are now reaching the markets of the United States, but some twenty species of parrots, parrakeets, cockatoos, lorikeets, lorys, macaws, lovebirds and parrotlets are regularly available from importation and breeding in California, so that it would appear that a steady supply of many interesting species can always be expected.

In addition to members of the parrot family, the new Bird House might well contain the present collection of birds of paradise, toucans, toucanets, hornbills, barbets, hummingbirds and

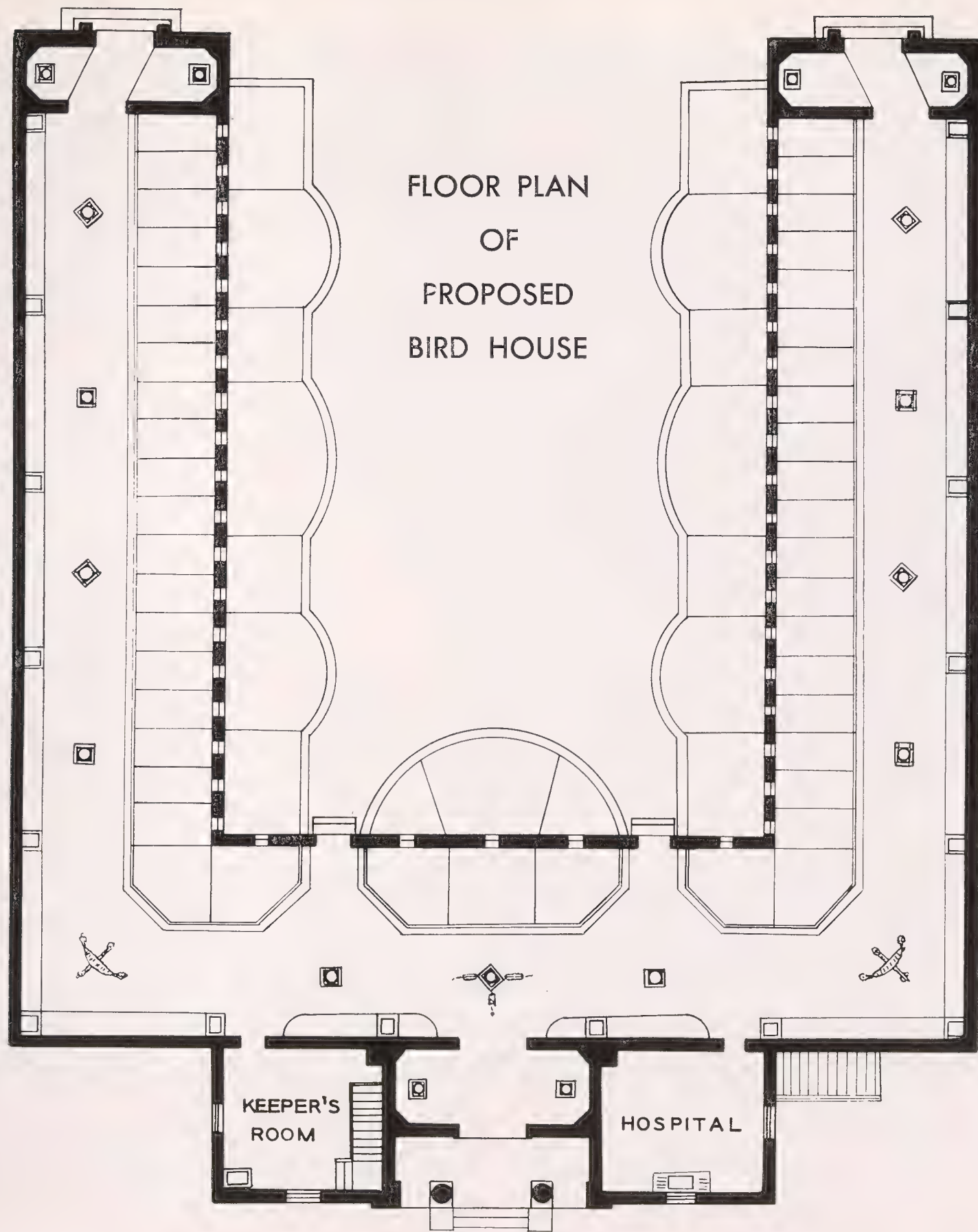
sunbirds. All members of this group must be housed singly, with very few exceptions, because of their disposition to fight. That requirement has taken up a vast amount of room in the present Bird House, to the detriment of the small perching birds.

The Society has every right to be especially proud of its series of birds of paradise, which is unrivaled in any other bird collection, and of its toucans, toucanets and barbets. These latter should occupy single cages and because of the necessity of finding such accommodations for them, the collection has been broken and scattered in several sections of the Bird House, so that its value as a unified collection is largely dissipated.

To fill the cages that would be emptied by the construction of a new Bird House, an almost unlimited supply of smaller birds is readily available. Small birds such as tanagers, waxbills, thrushes, weavers, wydahs and finches that are at present virtually lost among the hosts of small birds that share their cages, could for the first time in years be properly and impressively displayed, and in addition the Park would be able to exhibit such interesting species as nightingales and drongos that are not kept at



How the proposed new Bird House will appear from the south—a broad courtyard lined with large flight cages in which the birds may exercise. The Flying Cage at the right indicates the location of the new house.



present because they must be given individual cages.

It is to be expected that before the proposed new Bird House is finally worked out on paper and translated into stone and glass that it will incorporate many of the features which have, by experimentation in other zoological parks in this country and abroad, proved practical and desirable. One new type of construction involves glass-fronted cages for better visibility of the birds, a light source from the top, and comparative darkness in the public floor space in front. The principle, in fact, is somewhat similar to that employed in modern aquariums.

The bird houses in both the National Zoological Park in Washington, D. C., and the St. Louis Zoological Garden embody the new type of lighting and both have found it extremely effective.

Air conditioning is another important factor in modern bird house construction and in which we might well profit by the experience of other institutions. That type of ventilation is made necessary by the solid glass fronts of the cages, which shut off the normal flow of air. Pure air that can be warmed or cooled to the desired temperature passes constantly through the cages of the bird houses of the newer kind.

The proposed new Bird House is in the shape of a U, its arms each 104 feet long and its base 100 feet wide. The arms and the base enclose, on three sides, a courtyard 56 feet wide and 82 feet long. The exhibition cages are confined to the inner wall only of the building, so that flight cages may project into the courtyard—an extremely valuable provision to give the birds sunlight and exercise room. The public space in the hallway averages about 10

feet wide and through this, in semi-darkness, the public would pass to gaze upon the bird collection in strongly lighted cages.

Subject to such modifications in size as may be required by the needs of the birds that eventually will be housed there, the cage sizes designed by the architects, La Farge & Son, would appear to be adequate. Inside cages would be approximately 8 feet deep and 4 feet wide as a standard size, some of them being combined to make enclosures two and three times that width. Outside flight cages would vary in proportion—8 by 8 feet, 8 by 11 feet, 8 by 16 feet, and even larger.

The location tentatively selected for the new Bird House is the area just to the west of the large flight cage in the valley below the present Bird House, and directly north of the present Aquatic Bird House. A generous amount of open land is available there, with a full southern exposure, and it is intended to make the entrance to the house—flanked on one side by a keepers' room and on the other by a small quarantine room for newly arrived birds—on the north end, so that the open end of the court will admit sunlight into the outside flights and fully illuminate the interior cages through shaded glass tops.

The Giant Panda

First Described as a Bear, the Strange Creature from Szechuan Is
Now Classed Among the Raccoon-like Animals

T. DONALD CARTER

*Assistant Curator of Old World Mammals
American Museum of Natural History*

JUDGING from inquiries received at the American Museum of Natural History during the later part of December, 1936, New York City was turning giant panda-minded. The occasion for the sudden interest in this strange beast was the announcement in the daily papers of the arrival of a live baby giant panda, the first living specimen ever to have been brought from its mountainous home in western Szechuan Province, China, near the Tibetan border.

Mrs. Ruth Harkness made an expedition into the mountains of western China for the expressed purpose of trying to obtain a living specimen, and success crowned her efforts. According to Mrs. Harkness, an adult panda was observed leaving her den at the base of a hollow tree. Upon investigation, a cub, not over a month of age, was discovered. This young animal was brought into camp and fed on a special formula of powdered milk, cod liver oil, and syrup. On this diet, it reached New York City in perfect condition.

The remarkable success of Mrs. Harkness is apparent when it is remembered that very few of these animals have ever been observed alive by a white man and only four have fallen to their guns.

The giant panda dates back at least to the Lower Pleistocene. During the winter of 1920-1921, Dr. Walter Granger discovered fossil remains at Wan-hsien, Szechuan, some three hundred miles east of the present range. Although described as a distinct species, *Aeluropus* [*Aeluropoda*] *fovealis*,¹ the fossil showed remarkable similarity to the modern form.

The giant panda was first brought to the attention of science by a letter from the noted missionary collector, Père Armand David. The letter, under the date of March 21, 1869, addressed to the Museum of Natural History of Paris, was sent from Mou-pin, at that time in the principality of Tibet, but now in the province of Szechuan, China. This letter contained the statement that he was forwarding a collection of natural history specimens, including a bear which he believed to be a new species. Knowing that this shipment would not arrive in Paris for a long time, he requested that the enclosed description of the bear be published immediately. He named the animal *Ursus melanoleucus*. His description, published in the *Bulletin* of the Paris Museum of the same

¹ Matthew, W. D. and Granger W., 1923, *Bull. Amer. Mus. Nat. Hist.*, XLVIII, art. 17, p. 579.



Photo American Museum of Natural History

The giant panda group at the American Museum of Natural History has not yet been put on exhibition, but this shows the attitude the figures will assume. The panda on the left was shot by the Sage expedition.

year² was based on a specimen of a young animal in his possession and on his observations of mutilated skins of adults, all of which were of the same remarkable color. Later, he secured an adult female.

Upon receipt of the material at Paris, A. Milne Edwards noted that although the animal outwardly resembled the bear in form, the skull more closely resembled that of the common panda, *Ailurus*, and the raccoon, *Procyon*. Consequently, he placed the animal in a new genus, *Aeluropoda*.³ In 1874, Milne Edwards wrote a very complete account of the animal,⁴ illustrating the article with a series of plates.

From this time on the status of the giant

panda has been under discussion. The conclusions arrived at from recent anatomical investigations by Dr. William K. Gregory,⁵ agree with the earlier conclusions of Lankester,⁶ that *Aeluropoda*, as well as *Ailurus*, belongs to the subfamily *Ailurinae* of the family *Procyonidae*, or the raccoon-like animals. The accepted name of the giant panda is now *Aeluropoda melanoleuca* while that of the common panda is *Ailurus fulgens*.

The giant panda, known to the natives as "beishung," meaning "white bear," is a striking animal externally, and is about the size of our common black bear. The coat, over most of the body, is creamy white; ears, fore and hind limbs, and a spot about two inches in diameter

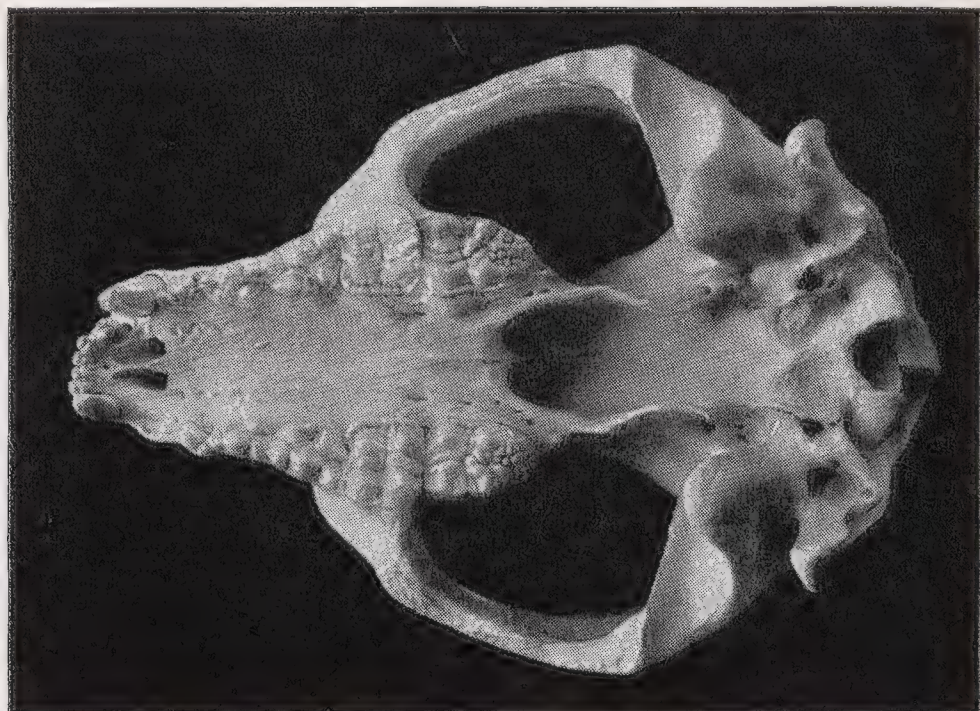
² Nouvelles Archives du Museum, t. V, *Bulletin*, p. 13.

³ Sur quelques Mammifères du Tibet oriental (*Ann. des sci. nat.*, serie 5, 1870, t. XII, art. n. 10). See also (*Compt. Rend.* 1870, LXX, p. 342).

⁴ Rech. Mamm. pp. 321-338, pl. 50-56.

⁵ 1936. *Amer. Mus. Novitates*, No. 878.

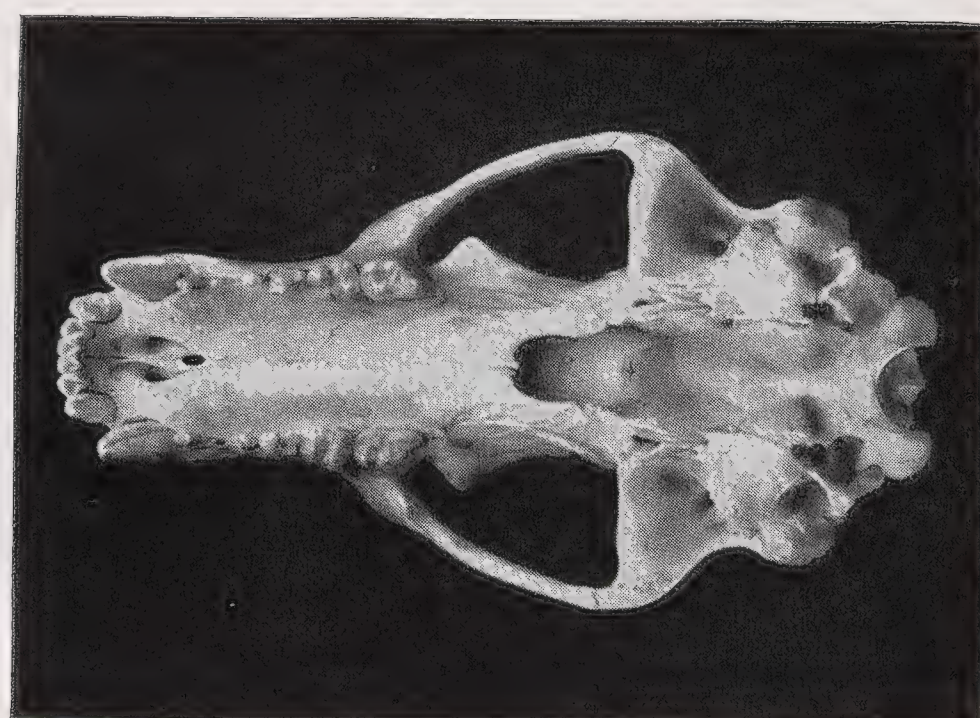
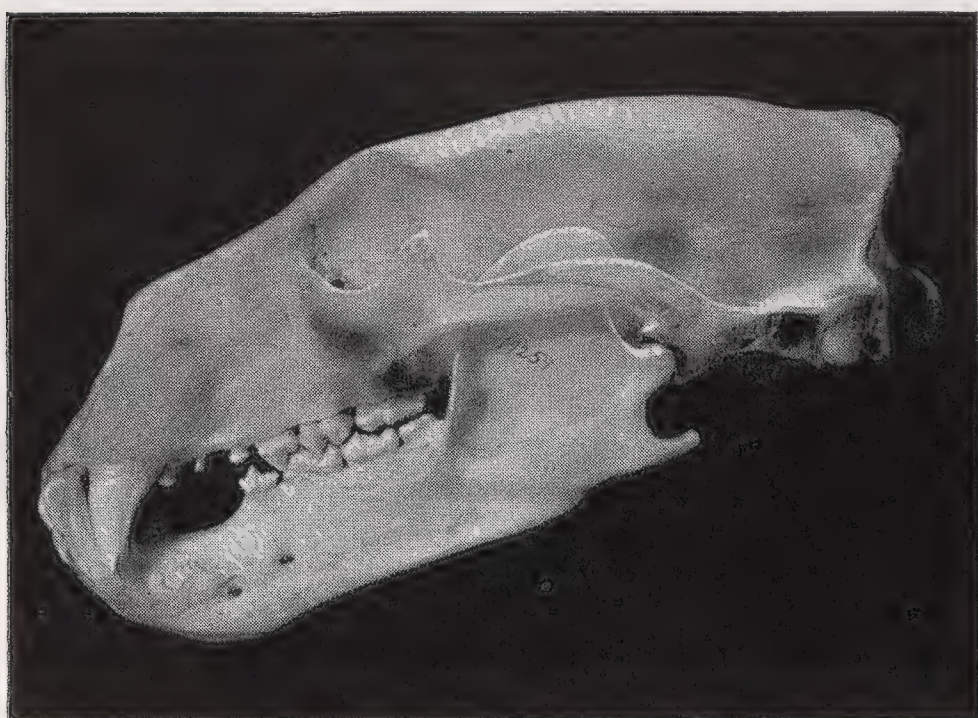
⁶ 1901. *Trans. Linn. Soc. London*, 1900-1903, (2) VIII, part 6, pp. 163-172.



Skull of giant panda.⁷ Length 290 mm.

Lateral.

Palatal.



Skull of polar bear. Length 360 mm.

Lateral.

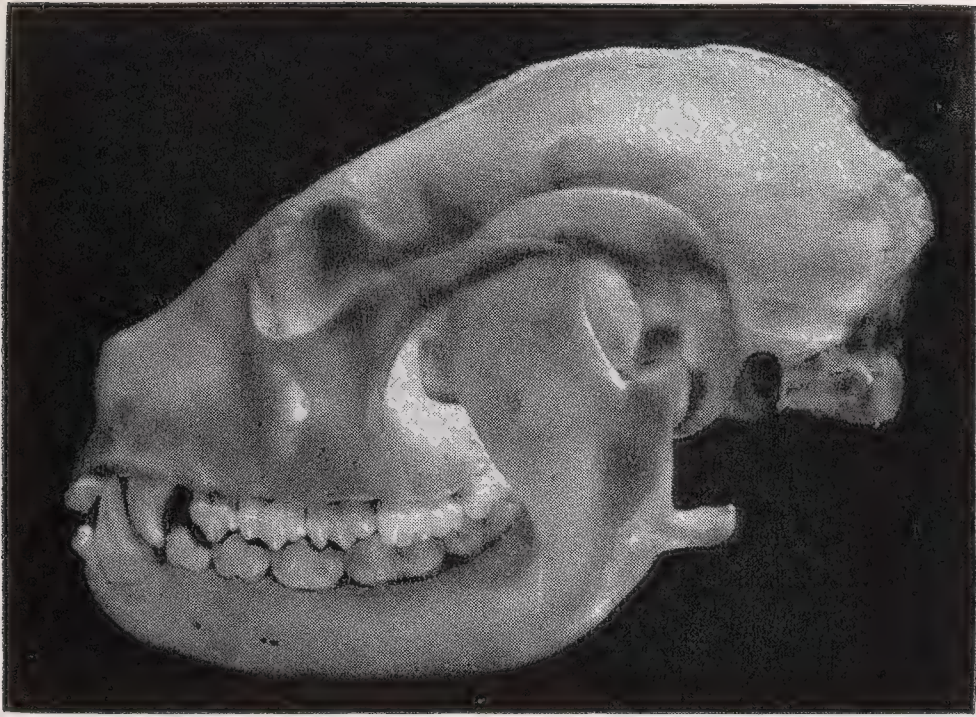
Palatal.

encircling the eyes, are black or a very dark brown, depending on the individual. The black of the fore limbs extends up over the shoulders, meeting on the back. At this junction, the dark stripe varies in width; on some individuals it is five inches across, while on others less than two inches, often intermixed with scattered gray hairs at its narrowest point, giving this line a broken appearance. On the upper hind limbs the light hairs of the body mingle with the dark hairs, causing a gradual change of color, rather than the sharp outline as in the case of the fore limbs. The head and face are a clearer white than the remaining light parts. The under parts are darker, a pale yellowish gray, giving a soiled

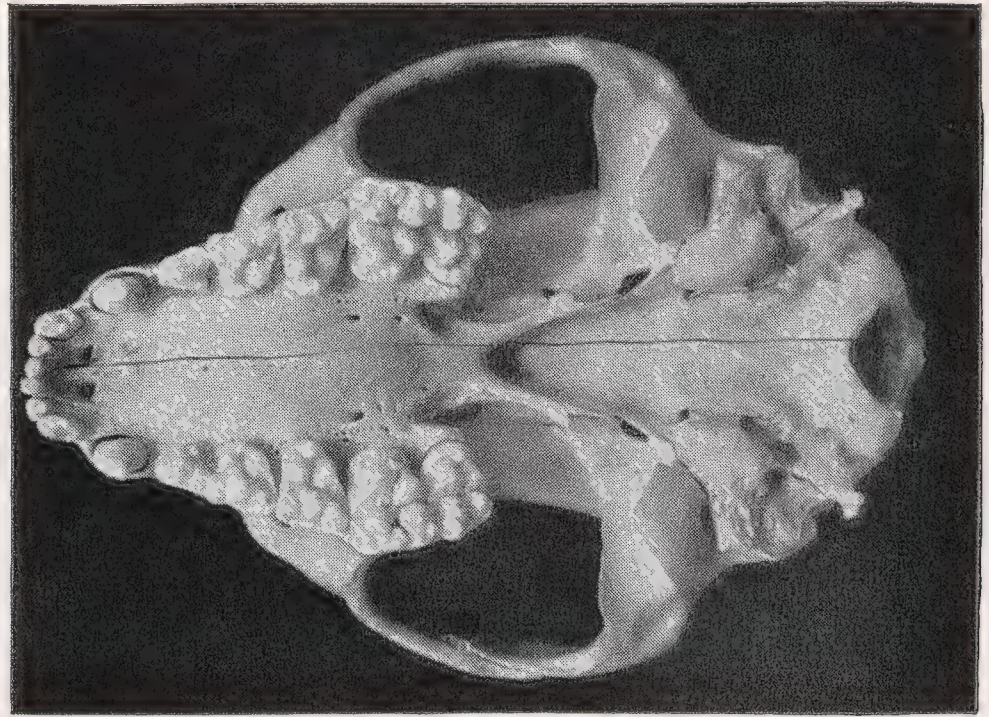
appearance to that part of the animal. The hair on the back is thick and wiry and of a woolly texture. The natives use the skins as sleeping mats, because of the springiness of the hairs. The round white face with the dark eye patches gives the animal a very clownish appearance.

As shown in the accompanying photographs, the skull of the giant panda differs widely from that of the bear. The general rounded shape is compared with the long skull of the bear; its short muzzle and very narrow forehead contrast with the long muzzle and very broad forehead of most of the *Ursidae*. The very high sagittal crest of the panda is in contrast to the relatively low crest, while the greater width and different shape of the zygomatic arch is also apparent. The angle of the mandible is strongly

⁷ Skull photographs on Pages 8 and 9 from American Museum of Natural History.



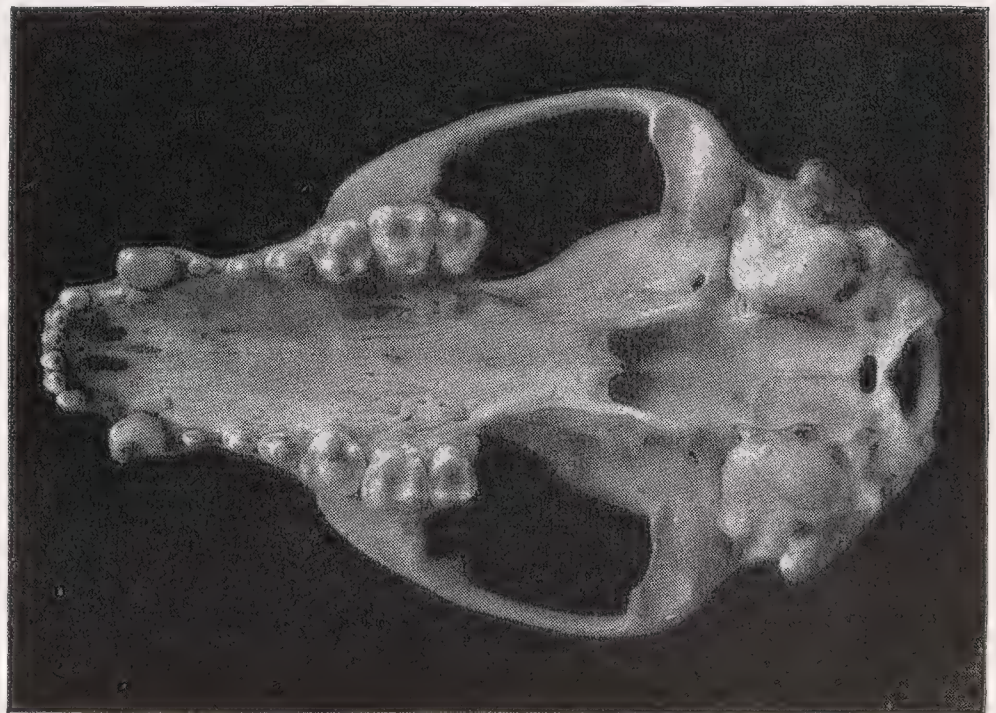
Skull of common panda. Length 110 mm.
Lateral.



Palatal.



Skull of raccoon. Length 115 mm.
Lateral.



Palatal.

inflected while that of the bear is straight. The narrow and high coronoid process with the backward turn of the tip differs from the broad lower process. The teeth show little resemblance. Both the molars and premolars of the giant panda are large and massive in comparison to those of the bear. They are exceedingly wide, containing many tubercles, thus giving the animal great grinding power.

The giant panda is found in the mountainous regions of western China, chiefly in the province of Szechuan. From the Yunnan border, it ranges north through this mountainous strip of western Szechuan although the exact northern limit has not been determined. Mr. Arthur De C. Sowerby informed me that he had indisputable evidence of this animal in the Tai-pei

Shan region of southwestern Shensi province; hunters had described the animal, showed him its droppings and places where it had been feeding.

These mountains are reminiscent of our own western highlands; towering, rugged peaks, with spruce forests reaching up to the timber line. Here, however, the similarity ends, for below the spruce forest there is generally found a zone of giant rhododendron, while below this, extending down to the valley bed, at an altitude of from 6,000 to 8,000 feet, grow dense forests of dwarf bamboo. It is in this almost impenetrable growth that the giant panda makes its home. The animal seeks this cover for protection and also for its food supply.

In 1934 the Sage West China Expedition,



Country such as this is the haunt of the giant panda — and these two photographs indicate most graphically why the quest is difficult and success uncertain. Bamboo covers the mountainsides and is virtually impenetrable. Both these scenes were taken at Cheng Wei on Chengou creek.

Photos Sage West China Expedition.

of which I was a member, spent many days on its trail and were able to note many interesting facts concerning its habits and at no time was any evidence found of any other food having been taken. Native hunters confirmed these observations. They claim that no other food is ever taken except the bamboo. In the spring and summer the bamboo shoots and young growth appear to be the main article of diet while during the winter the leaves and even the large woody stalks are devoured. We found sections of the stalks two inches long and three-quarters of an inch wide in their droppings. It is evident that much time must be spent in feeding to enable so large an animal to obtain enough nutriment from the bamboo to sustain life. In the country inhabited by these animals, their droppings are very common. Bill Sheldon estimated that at an average of every 500 yards he found droppings of an animal he was following.

Living as it does amid the bamboo, where there is no necessity of exerting itself for a meal, the panda has little need for keen wit; consequently, it is a dull minded, slow moving animal, traveling with head held low, paying little attention to what is going on about it.

In the dark recesses of the bamboo the animal has few foes except man. Leopards, wild dogs, or a bird of prey might take an occasional young one, but the old animal has little to fear.



The giant panda does not hibernate as the bears do, but is out all winter, leaving its imprints in the snow.

We found that pandas apparently preferred eating in the early morning and to some extent at night, and that by ten A.M. they would retire for their siesta. Often this would be at

the base of a tree and on one occasion we saw evidences of it on the top of a low stump. At one place, in a small natural overhang of rocks, a panda had made a bed of leaves and pieces of bamboo. From the looks of this place the animal had been coming regularly to this spot. Sheldon came upon the track of an animal one morning and following through the thick growth soon came to a place from which the animal had just arisen. He was sure that he had heard the animal as it left its bed, but on account of the thick covering he was unable to see it. He followed the animal for the greater part of the day but never obtained a sight of it. Places were discovered where the animal had reared on its hind feet and scratched the bark from a tree, after the manner of a bear. From the evidences we concluded that there were at least eight pandas in the section of the mountains over which we hunted. They are great wanderers and at times leave the fastness of the bamboos and follow along the open ridges. In

their wanderings they seemed to us to cover a certain circuit, returning to a given locality in perhaps a week's time. They appear to prefer to travel alone, but upon two different occasions we came upon evidence of two traveling together. In both instances the animals appeared to be adults.

The giant panda climbs readily and enjoys a sun bath from the crotch of a tree. This often proves its undoing, for in this position, it is a conspicuous object and easily attracts the eye of a hunter.

It is strange that so few of the young have been noted. Most of the tracks that we followed were made by animals apparently of about the same size. Little credence can be given to the statements of natives, most of whom say that the animal is not fully mature until it is six years of age. This seems quite unreasonable, for if this were the case, a greater number of immature individuals would be collected by the native hunters.



The little panda bears virtually no external resemblance to its giant relative. It is, however, handsomely marked in reddish-brown, black and white.

From every indication the giant panda has but a single young. The statement of our most reliable guide, that they give birth to their young every other year, may also be true. The mature female collected by the Sage Expedition on December 8, 1934, gave no evidence of having recently had a young one.

The chief device used by the natives in the taking of this animal is an automatic spear trap. A spear with an iron head and a wooden shaft is placed horizontally, at the required height, between two upright sticks. To the end of the shaft is attached a sapling which is pulled back and caught with a trigger. This sapling forms the spring. A cord runs from the trigger across the trail upon which the panda is supposed to travel. When the cord is tampered with the spear is driven forward with tremendous speed, guided by the upright stakes. The spear is so set as to strike near the animal's heart. Not only giant pandas, but such large animals as the takin are killed in this fashion.

The honor of being the first white men to stalk and shoot the giant panda belongs to Theodore and Kermit Roosevelt. This achievement, which occurred on April 13, 1929, proved to be the crowning point of the Kelly-Roosevelt-Field Museum Expedition and is graphically described in their book, "Trailing the Giant

Panda." Their prize is now one of the group in the Field Museum of Natural History in Chicago. The second party of white men to acquire fame by having one of their number shoot a giant panda was the Brooke Dolan Expedition under the auspices of the Academy of Natural Sciences in Philadelphia. Ernst Schaffer shot his panda as it was sunning itself in a tree. His specimen is now one of a group in the Academy Museum.

In August of 1934, the Sage West China Expedition left Shanghai for the mountains of western Szechuan to make a collection of mammals and birds for the American Museum of Natural History. The primary object of the expedition was to secure the animals and the necessary accessories for a proposed giant panda group. The personnel consisted of Mr. and Mrs. Dean Sage, Jr., Mr. William G. Sheldon, and the author. After a memorable trip up the Yangtze river and through its awe inspiring gorges the party arrived at Chungking. We continued overland by automobile to Chengtu. Here coolies were hired and five days brought us to Wenchwan. Two more days brought us into the higher mountains. The first three weeks were spent above timber line collecting a series of the blue sheep or burrhel, *Pseudois nayaur szechuanensis*. The fogs which



Automatic spear traps are generally used by the natives to take giant pandas. Note the sharp head of the spear between the uprights, and the cord stretched across the path. By pushing against the cord the animal releases the force of a bent sapling, which drives the spear forward.

Photo Sage West China Expedition.

hung over the mountains gave us only two clear days and greatly handicapped our hunting. Returning to the base camp we dried the skins already secured and then moved camp up to a fork of the river where panda were reported by the natives. Here we camped on the roof of a native farm house. A stream flowed down through this valley and on the steep sides grew dense areas of the dwarf bamboo. Once inside this forest, hunting was impossible. We could see but a few feet ahead, the dried leaves of the bamboo on the ground made it impossible to proceed without a great deal of noise, and the roots of the bamboo constantly tripped us. To make hunting more difficult, the mountain side was so steep that normal walking was impossible and later, when the going was icy and the forest full of snow, we were forced to wear native made shoes with straw soles, to the bottom of which were fastened iron cleats.

Such was the type of country through which we were forced to penetrate. On account of the denseness, it was impossible to surprise our quarry, as we would announce our presence long before we had knowledge that game might be near. We would follow the stream beds where traveling was not quite so precarious, and gaze up over the tops of the bamboos with the hope that we might be able to tell by the movements of the branches that a panda was feeding beneath. We would also, with our glasses, scan the spruces above the zone of bamboo in the expectation that we might be able to find an animal sunning himself among the boughs. But all to no avail. Finally we decided to try hiring native dogs—and found them quite useless. They much preferred chasing deer to pandas.

One day, Bill Sheldon and I with two hunters and their dogs came upon the track of a panda crossing our trail. The dogs were let loose and later by their barking we knew that they were near their quarry. When I reached a point of vantage, I saw my first panda disappearing over the brow of a hill 400 yards away. The dogs were yapping at his heels but he did not seem to be trying to exert too great an effort to get out of their way. He made no move to fight the dogs as a bear would have done. The dogs did not appear to attack the panda, running along side and behind barking. Soon after they had

disappeared over the hill the dogs gave up the chase and returned. Sheldon said that when he first saw the chase there were two pandas; the first had gone over the hill ahead of the one that I had seen. Shortly after this we decided to give up the pursuit of the pandas for the time being and wait until there was a tracking snow. So camp was again moved and we spent our time adding other animals and birds to our collection. Skins of takin, serow, goral, musk deer, tufted deer, wild boar, black bear, the small panda and numerous smaller animals were soon hanging in our drying tents. We also collected numerous birds. While hunting the burrhel we had collected a number of the beautiful Chinese Impeyan pheasant, *Lophophorus lhuysii*, a bird quite similar to the Himalayan Impeyan, *Lophophorus impejanus*, but lacking the crest. At this present camp we added Temminck's tragopan, *Tragopan temminckii*; red-necked Koklass pheasants, *Pucrasia xanthospila ruficollis*; golden pheasants, *Chrysolophus pictus*; the rare Szechuan form of the black-necked pheasant, *Phasianus colchicus süehschanensis*; a series of what may be a new form of the blood pheasant, *Ithaginis sinensis*; as well as many other interesting birds. It was here that a native hunter brought in the skin and skull of a giant panda he had shot the day before. After twenty-four hours of bickering it was finally purchased at a reasonable price.

Finally, with but two weeks left, we decided to return to hunt the pandas and try to record some of their habits. By this time there was a tracking snow, so again we took up the trail and hunted unsuccessfully until finally we realized that we had but three days left in the field. Again we resorted to dogs, but the dogs were not fierce enough to hold and worry the animal. Word came to us of a vicious dog, a dog that was not afraid to tackle anything, so we resolved to give him a try. It took a day to secure the dog, so that by the time all was in readiness, I had but one more day in which to hunt. I was to return to Tsao Po in order to pack the skins left there. We were out at sunrise. Since it was my last hunt, I was given the opportunity to choose the hunting ground. The day before I had noticed the tracks which had crossed the stream about three miles above camp. I mentioned this and we were soon on our way. A little after noon the dogs picked up the

trail but the panda continued over the ridge and soon the dogs returned.

The next morning, I set out for Tsao Po, the first step of our homeward journey. Two days later we joined forces at an appointed spot on our homeward trail and here I heard the following unusual story.

The day after my departure Dean and Bill had returned to the place where we had hunted the day before I left. As this was their last day of hunting and would be their last opportunity to shoot a panda, they decided to do everything in their power to make the day a success. Four natives and their dogs, including the newly acquired ferocious one, accompanied them. After three hours of strenuous climbing, they came across an old trail of a panda and followed it. Two and one-half hours of following this trail led them nowhere and they stopped to rest. It was then decided that as the day was far spent and there was little hope of overtaking the panda, they would unleash the dogs with the hope that they might come upon a fresh trail.

They followed along the old trail but still the dogs showed little interest. The rest of the party had disappeared ahead of Dean and his gun bearer. Dean had just climbed upon a ledge, when he noticed Bill fifty yards above him. Suddenly the dogs gave tongue. From the noise made by the breaking of the bamboo Dean concluded that it was some large animal. His guide

said the single word, "*Beishung*"! On account of the thick tangle of the stems and leaves his chances of even seeing were very remote. From the sound, the dogs were driving the animal up the ravine toward him. He heard a deep growling and then, not sixty yards away, he saw the panda. His first shot missed but the animal turned and headed straight for his ledge, not moving rapidly, but shuffling along in a rapid walk. The head was carried low and it appeared as if the animal was looking at the ground and did not notice the hunter. The fierce dog was worrying her and at one time the panda turned and bit the dog on the foot. She continued on until she was within ten feet. At this distance, Dean fired. Simultaneously, Bill fired from above and the animal rolled down the slope.

The animal proved to be an adult female in good condition and measured four feet eleven inches from the tip of her nose to the end of her tail. The tail itself was about six and one-half inches and the shoulder height was two feet three inches. The girth at the thorax was three feet and six inches and around the belly four feet and six inches. The estimated weight of this panda was about 225 pounds.

We were able to bring back to the Museum the skin, skeleton and also the viscera. It is the first time that an opportunity for the examination of the internal anatomy of the panda has been afforded to science.



*Back from the panda hunt and resting on the roof at Cheng Wei, with a giant panda skin drying on the great basket.
Seated: Mrs. Sage, Mr. Sage, Mr. Sheldon.*

Australia's "Wild Zoo"

Natural Bushland Is the Setting for the Sir Colin MacKenzie Sanctuary,
Although It Is Within Fifty Miles of Melbourne

CHARLES BARRETT, C. M. Z. S.

Honorary Editor, "The Victorian Naturalist"

VICTORIA'S largest sanctuary, an area of 101,000 acres, is well stocked with marsupials and native birds, but, being nearly a whole day's motor run from Melbourne, has comparatively few visitors.

Our "Wild Zoo" attracts thousands of nature lovers and holiday makers because it is within easy distance of the city and offers closeup views of koalas, the platypus, kangaroos and wallabies, emus and other notable Australians, in picturesque natural surroundings.

Oversea visitors are taken to Healesville to be introduced to "Splash," the platypus, and our loveable little "bears," perched aloft in gum trees. Many Americans have pleasant memories of a day at the Sir Colin MacKenzie Sanctuary, as the Wild Zoo is officially termed. It is, in some respects, unlike any other zoological park in the world. Plans for development include more than doubling the present area enclosed and adding many species to the already varied population. Both a sanctuary for Australian fauna and a pleasant place to wander in, our Wild Zoo is less than fifty miles from Melbourne, the State capital with one million people, and seems destined to become famous the world over.

Originally part of a big aboriginal reservation called Coranderrk, the sanctuary consists of nearly eighty acres of bushland, with a creek flowing through it, and forested hills 'round about that are high enough to be termed mountains.

There are shadowy tracks and broader pathways, beautiful groves of tree-ferns, and tall eucalypts which Nature planted centuries ago. Off the path from the main entrance gateway one may step into virgin bush tenanted by bell miners, Australian thrushes, robins, and many other birds. Dense scrub walls in the track here and there, with sunny stretches between, and finger-posts attached to tree-boles lure the

visitor from the main "highway." In the center are open spaces with rustic tea houses, a small museum, and seats in the shade of old trees.

Folk linger here only to rest and for refreshment. Any day, strolling through the Sanctuary, one meets with parties and solitary visitors, enjoying the wildness of the place. It is easy to imagine that you are in untamed bushland, and not an area enclosed. The illusion is not all illusion, for many of these acres have been left in their age-old state and the animals hardly realize that their freedom is curtailed. Apart from the cockatoos and parrots, in large flight-aviaries, the inhabitants of the Sanctuary are in only semi-captivity; they have room to roam and their environment is practically the same as that of their cousins in the bush outside. Hardly a corner of this zoological park in the hills that is not beautiful with shrubs and trees, or tall ferns growing wild. Happily, little has been done in the way of garden making. The ideal is wildness and when the hundreds of acres available for extension have been claimed, they, too, will remain unspoiled by "improvements" except for a wire fence six feet in height.

The kangaroo paddocks and other enclosures are fenced with wire netting and have a sheet iron top piece in some cases. These fences are not obtrusive. The cage is convenient as temporary quarters for new arrivals, but few of the tenants are permanently caged and all enjoy as much freedom as possible. The koalas have an acre of forest to themselves, and dozens of grand old gum trees to choose from.

Our Wild Zoo, as a zoological park, is about four years old, but as a sanctuary it existed a generation ago. Sir Colin MacKenzie, Director of the Australian Institute of Anatomy, at Canberra, capital of the Commonwealth, originally formed a small collection of marsupials which were housed in this area, for research

purposes. When he moved to the capital, the Sanctuary was handed over to a Committee of management representing the Healesville Shire Council. A financial grant enabled the committee to have pathways formed and enclosures made. Further development work became possible as the Wild Zoo became known to the public. The yearly attendance is about 20,000 and a nominal charge for admission provides funds for maintenance, etc.

When a special committee was appointed by citizens of Melbourne to select the best site for a Wild Zoo, this Healesville area was chosen unanimously. I was one of the selectors and after many visits to the Sanctuary and other proposed sites I am convinced that our choice was right.

Less than 500 feet above sea level, with a

natural stream flowing, with great forest trees and noble tree-ferns and tracts of underbrush, the Badger Creek Sanctuary is suited for native animals of many kinds, and innumerable birds. The climate is mild and there is plenty of natural herbage. Is it any wonder that the mortality rate among the inhabitants of our Wild Zoo is infinitesimal, or that many species breed freely there? Kangaroos and their kin, emus and other birds, all are healthy and contented.

An Australian who spent nearly thirty years in South Africa is the genius of our Wild Zoo. He, more than any other man, deserves praise for the success of a notable experiment, and as honorary curator he is still closely associated with the Sanctuary. A man of ideas and vision; tireless too. He is known all over Australia as the "Platypus Man," but was christened Robert



Australia's "Wild Zoo" abounds in such tropical luxuriance as this wild fern gully. It is in regions such as this that the spectacularly beautiful lyre-bird is to be found making its nest and roaming free.



The kookaburra bird is common around the sanctuary and its loud laughing notes are often heard there.

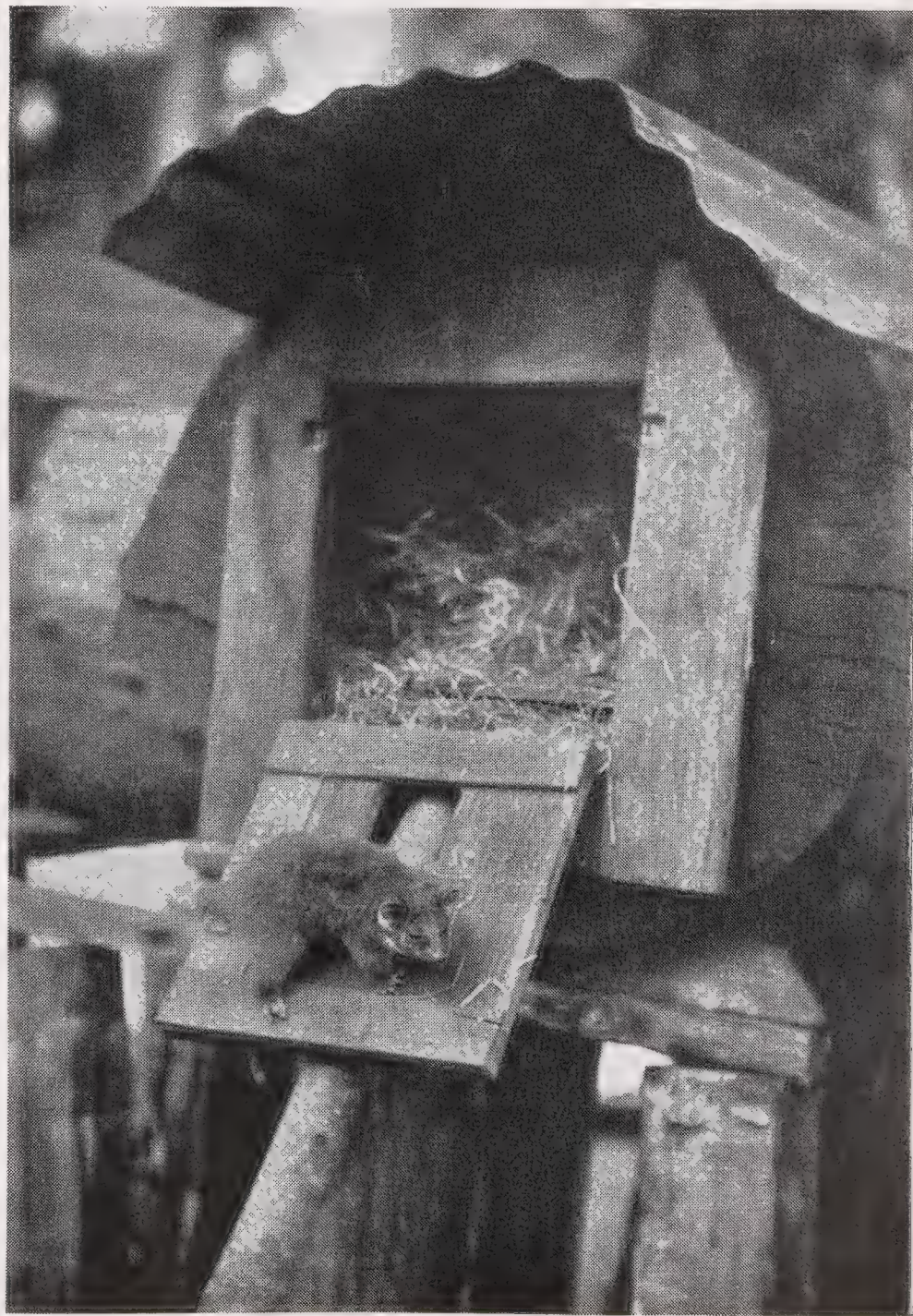
Eadie. His beautiful country home looks down on the Sanctuary, which he visits daily.

Mr. Eadie, during his early life in South Africa, was associated with the Kruger National Park, and on returning to his native land found in the Healesville Sanctuary a field for the realization of his views on keeping wild animals in semi-captivity under ideal conditions. He designed a platypussary, in which one of the monotremes lived for months and was seen by thousands of people. This was the most successful of many attempts to domesticate the platypus; it was followed by another, on Mr. Eadie's own estate, which became an outstanding achievement and earned for my old friend his nickname of "Platypus Man."

Robert Eadie has devoted the best part of four years to Splash, the platypus. Leisure hours not given to the Sanctuary and his other interests have been given to observing the animal. At all hours, day and night, Mr. Eadie

has been a patient watcher. He and his wonderful pet play a game they invented. A small hand-mop is waved about in the swimming tank; Splash, rolling over, seizes it with duck-bill and his clawed feet, clinging so tightly that he is drawn out of the water, only to fall back and begin all over again. He loves the game and enjoys an audience—now. For long after he became the sole tenant of the platypussary, Splash was timid. Taming him, one of the shyest of animals, demanded infinite patience and understanding. Mr. Eadie's reward he has shared with the world of nature lovers. Some weeks more than a hundred visitors go up from the Wild Zoo to "Glen Eadie" and are introduced to Splash, now more than four years old and as healthy and happy as you please.

Splash is a friend of mine, too, but he does not know me as he knows his owner, who alone can handle him freely. It is not fancy, but fact: Splash, with a dozen people around his tank,



Huts such as these are daytime shelters for phalangers, which feed at night in the eucalyptus trees.



(Upper). Entrance to a wombat's burrow. These lumbering animals are common in the ranges. (Lower). Traps roughly made of wire netting are set before the burrows to capture wombats for liberation in the "Wild Zoo."

recognizes Mr. Eadie and never mistakes his greatest friend for a casual acquaintance or a stranger. There is perfect understanding between them.

The swimming tank measures about six feet in length and is three feet deep. Every morning it is half-filled with fresh water and Splash disports himself in full view many times daily. He likes to be looked at; is happiest when the cynosure of many pairs of human eyes. He responds to the lure of the mop and with charming nonchalance changes from play to feeding when a handful of worms, some big beetle-grubs, or a few tadpoles are placed in the water or his wide, shallow platter. The meal is often interrupted because Splash fancies a bout with the mop. Tired at last, he retires to his sleeping apartment, connected with the tank by a tunnel through a dividing wall. The tunnel is ingeniously constructed and of the type that a platypus itself would form in a river bank.

By soft whistling, Mr. Eadie can often persuade Splash to enter the tank, even though the animal has been sleeping.

Splash was four or five months old when captured in February, 1933. Last year he reached maturity and is a very fine specimen of *Ornithorhynchus anatinus*; 22 inches in length and weighing 4½ lbs. During his captivity he has grown 11 inches. He eats 16 ounces of worms and grubs daily, and in the evening has two fowl's eggs, specially prepared as supplementary food. Occasionally he is given tadpoles and beetles, as luxuries. In his first three years he consumed more than half a ton weight of earthworms and more than 2,000 eggs. He is an expensive pet, for in the dry season worms are scarce and cost one shilling a 2-pound tin. Boys earn pocket-money by worm-hunting for Mr. Eadie, who has spent perhaps £200 on Splash.

"Tame as a kitten, and as playful." That is Mr. Eadie's own description of Splash who, though not actually a tenant of our Wild Zoo, is always mentioned in connection with it.

Next to the platypus, koalas or native bears are favorites with visitors to the Sanctuary. There is a flourishing colony of koalas in the gum tree paddock, while one or two are on view in a small enclosure, a high fence about a lopped tree. Visitors are allowed inside and



A platypus, photographed when the first specimen was exhibited at the New York Zoological Park in 1922.

take close-up photographs of the amiable little animals.

In their own forest, the koalas literally live high, as a rule. In one tree several may be perched, wedged comfortably in a fork or clinging to stems and foliage, while they eat the tender shoots. Often you see one 150 feet above

the ground, perhaps 200 feet in the tallest trees. They fall sometimes from high boughs, land on their feet like cats, and go lumbering off to climb again, apparently unharmed. The koala's fate as a really wild animal is sealed. We can save the species from extinction in Victoria only by protection in sanctuary. I doubt whether there are 300 koalas in the State now, outside the Wild Zoo and among the gum trees on Phillip Island, a resort of holiday seekers. They are the most lovable little creatures imaginable, yet millions have been killed for the sake of their pelts. Down south we gave them full protection almost too late; in the north of Queensland, koalas are plentiful still, but not so many years ago an open season was granted to the fur hunters and they took a very heavy toll.

Bird life in the Wild Zoo, apart from that in the aviaries, is delightfully varied. There are lyre-birds up Healesville way, and in a tree-fern gully you may have glimpses of the master mimic, whose display on his dancing mound is

among the wonderful sights of birdland. Satin bower-birds also are found in the district, while the notes of honey-eaters, shrike-thrushes and whistlers (*Pachycephala*), are heard as one wanders down shadowy and sun-flaked trails.

Wombats dwell in the hills round about and dig long and roomy burrows, into which a child might crawl.

The platypus is not our only egg-laying mammal; the spiny anteater, or echidna, is also on the Sanctuary list of exhibits. Echidnas, unlike the platypus, are commonly met with out in the open. They stroll around in rocky places, cross country roads, and even enter yards and gardens. Several have been brought to me by motorists who picked them up by the wayside. One I kept for months as a pet. He drank milk and egg-flips, lapping with a long, ribbon-like tongue. If the New York Zoological Park may not have a platypus, echidnas are easily obtained and not very difficult to take across the seas.

All photographs, except on Page 19, by the author.



On a ramble through the "Wild Zoo," the visitor may often come upon the queer spiny anteater, or echidna. Long claws that are adapted for rapid digging are to be seen on the hind foot of the animal in this picture.



Young tarpon, averaging a little more than one foot in length.

Young Tarpon at the Aquarium

There Is Mystery in Their Early Life, for They Are Peculiarly Scarce, and Their Growth to Adult Size Is Eagerly Awaited

C. M. BREDER, JR.

MR. Louis L. Babcock, an enthusiastic follower of tarpon angling, has for many years been accumulating data of divers sorts on that fish. This information he finally made available in a privately printed volume, limited edition, for circulation among those interested. This book, "The Tarpon," has just appeared in its fourth edition, 175 pages. Considerable data have been added since the third edition of 1930, and it is with much satisfaction that we recommend it to all those interested in either the angling or biological aspects of the impressive tarpon.

Because of the general interest in this fish the Aquarium has long wanted to be able to exhibit the species, which for once carries a technical name that should certainly not impress the layman with horror—*Tarpon atlanticus*. From time to time, during the long history of the Aquarium, specimens that have straggled north in summer, from their Florida and West Indian haunts,

have found their way into the exhibition tanks, usually through the intervention of local commercial nets. These were all fairly large fish, over three feet in length, and more apt to be close to five. Their tenure of life was short, less than a week in most cases, and they were usually so bedraggled when received that it was evident that continued survival could not be expected. Attempts to bring similar-sized specimens direct from the south through our own efforts, in the same way that we obtain many other species, also yielded no results, and we finally concluded that the tarpon is an exceedingly delicate fish, at least so far as maintenance in an aquarium is concerned. In one way this is not strange, since the tarpon is somewhat related to fishes that are notoriously difficult to maintain in aquaria—the herrings. Few of these are ever satisfactorily established in any aquarium.¹

¹ N. Y. Z. S. *Bulletin*, 1936. 39 (4): 149-153.

It will be noted that we have referred only to the large fish. Frequently it is more satisfactory to handle young fish and to allow them to grow up in the tank provided for them. Why not, then, try little ones? The reason for this is rooted in a peculiar feature of our knowledge, or lack of it, of the life history of this fish. Briefly, young tarpon are peculiarly scarce. Illustrative of this is the fact that naturalists generally think that the finding of a few small ones is worthy of recording. The *Bulletin* has reported two such finds within recent years. Dr. Beebe found some in Haiti in 1927,² and the present contributor found young tarpon in the Bahamas in 1933.³ Mr. Babcock in the latest edition of his book, refers to these and similar records.

A peculiar thing about these finds is that most of them occur in foul back waters disconnected from the ocean and which are of such a nature that therein few other marine species could survive. Both of the finds specifically mentioned were of such a kind, a condition also noted by the energetic Mr. Babcock. Consequently, when we discovered that considerable numbers of small tarpon were being taken by the new Key West Aquarium, we hastily endeavored to obtain some. Thanks to the cooperation of the Mallory Steamship Co., this was easily arranged and on October 21 we received fifteen tarpon ranging from about six to nine inches, in excellent condition. It would have been desirable to measure them, but we were so fearful of possible damage that we omitted this item. Shortly after receipt, three died, but the remaining twelve are thriving and at this writing are noticeably growing. They feed with the curious vigorous snap so characteristic of hungry adults.

² N. Y. Z. S. *Bulletin*, 1927. 30 (5): 141-145.

³ N. Y. Z. S. *Bulletin*, 1933. 36 (3): 65-67.

Examination of the scales of one which died showed no evidence of any growth markings. This fish was about $7\frac{1}{2}$ inches long,⁴ and in its lack of scale markings contrasted strongly with the fish taken on Andros Island. Those, which ranged from about $7\frac{5}{8}$ to $13\frac{3}{8}$ inches, showed numerous growth marks. The smallest fish, closely comparable to the present, carried marks on its scales that suggest an age from one and a half to two years. Mr. Babcock thinks that these fish, land-locked in foul pools, become stunted, which would be in keeping with this data since presumably the present material was not taken in such a locality. From his studies the indications seem to be that the tarpon spawns sometime from June to September. Our fish, caught in October, would seem to check with the earlier part of this period and if so show a rapid growth during their early life, which is more or less to be expected.

In explanation of the ability of young tarpon to exist in foul water, Mr. Babcock looked to the swim-bladder as a possible accessory breathing organ. In this study Dr. S. F. Hildebrand took part and figures an interesting dissection showing the lunglike nature of this organ in a specimen about one foot in length. We were interested to check on this in our fish about half that size and to find the structure essentially as described by him for the larger fish. Undoubtedly this accounts for their ability to live in water too foul and low in oxygen content for most sea fishes.

Unfortunately, we have not been able to date to elicit the exact locality from which these fish were obtained. Nevertheless, we feel considerable satisfaction in sitting back, as it were, while we wait impatiently for them to grow into full tarponhood.

⁴ 158 mm. standard length. 191 mm. total length.



A Saiga from the Steppes of Siberia

A Strange, Goat-like Antelope from Hitherto Almost Inaccessible Plains
Is Exhibited at the Zoological Park for the First Time

CLAUDE W. LEISTER

A NEW and important exhibit at the Antelope House is a healthy specimen of the saiga antelope, *Saiga tatarica*, one of two animals received from Russia by a New York animal dealer and purchased by the Zoological Park on November 16, 1936. Thus another name was removed from the list of the world's animals which have never been exhibited in the Zoological Park. This accession to the Society's collections adds an especially interesting animal to our exhibits, for the saiga is one of the strangest of the antelopes.

If we disregard the hartebeests as being in a class by themselves, the saiga can be considered as one of the homeliest and most ungainly of the entire antelope group. It stands about thirty inches high at the shoulder, approximately the size of a domestic goat or sheep, and likewise resembles a goat or sheep in body form. In fact, any person not zoologically minded would be inclined to believe that the animal is more goat than antelope.

The saiga's most remarkable characteristic is its puffy, inflated nose. Another antelope, the little African dik-dik, has almost the same nose in miniature but the two animals are not at all closely related. Our only North American animal with a somewhat similarly shaped nose is the moose.

Like some other northern mammals, the saiga changes the color of its coat with the seasons. In summer the color is a light yellowish-brown with white underparts. In winter the hair on the upper part of the body is much longer, and with the assumption of the winter coat the color changes to white or grayish-white, somewhat darker on the back. The old males are also supposed to grow a long beard, extending from the chin down the throat to the breast. Our saiga is now in his winter coat and it will be interesting to note the change to summer conditions which should occur during the coming spring.

The horns of the saiga are borne only by the males. They are about a foot in length and a pale amber color with a peculiar waxy appearance. They are slightly ringed and somewhat goat-like or ibex-like in shape. The earliest good account of the saiga was given by J. G. Gmelin, who saw many of the animals on his travels through Siberia between 1733 and 1743. It appeared to him to be a new species of wild goat, and, probably influenced by the shape of the horns, he named it *Ibex imberbis*. It was not until 1843 that it was properly recognized as an antelope and the name *Saiga* proposed by Gray. *Saiga* is from the Russian *saiga* or *saigàk*, meaning antelope.

The saiga's horns, like those of several other animals, have gained the reputation among the Chinese of possessing desirable medicinal properties. It is therefore an animal with a price on its head and in suitable territory native hunters can make enough from the sale of saiga horns, which they secure during the summer months, to support themselves through the rest of the year. In central Asia the horns can be found in many native shops and consignments from the interior are regularly sent to Peiping to be converted into medicine.

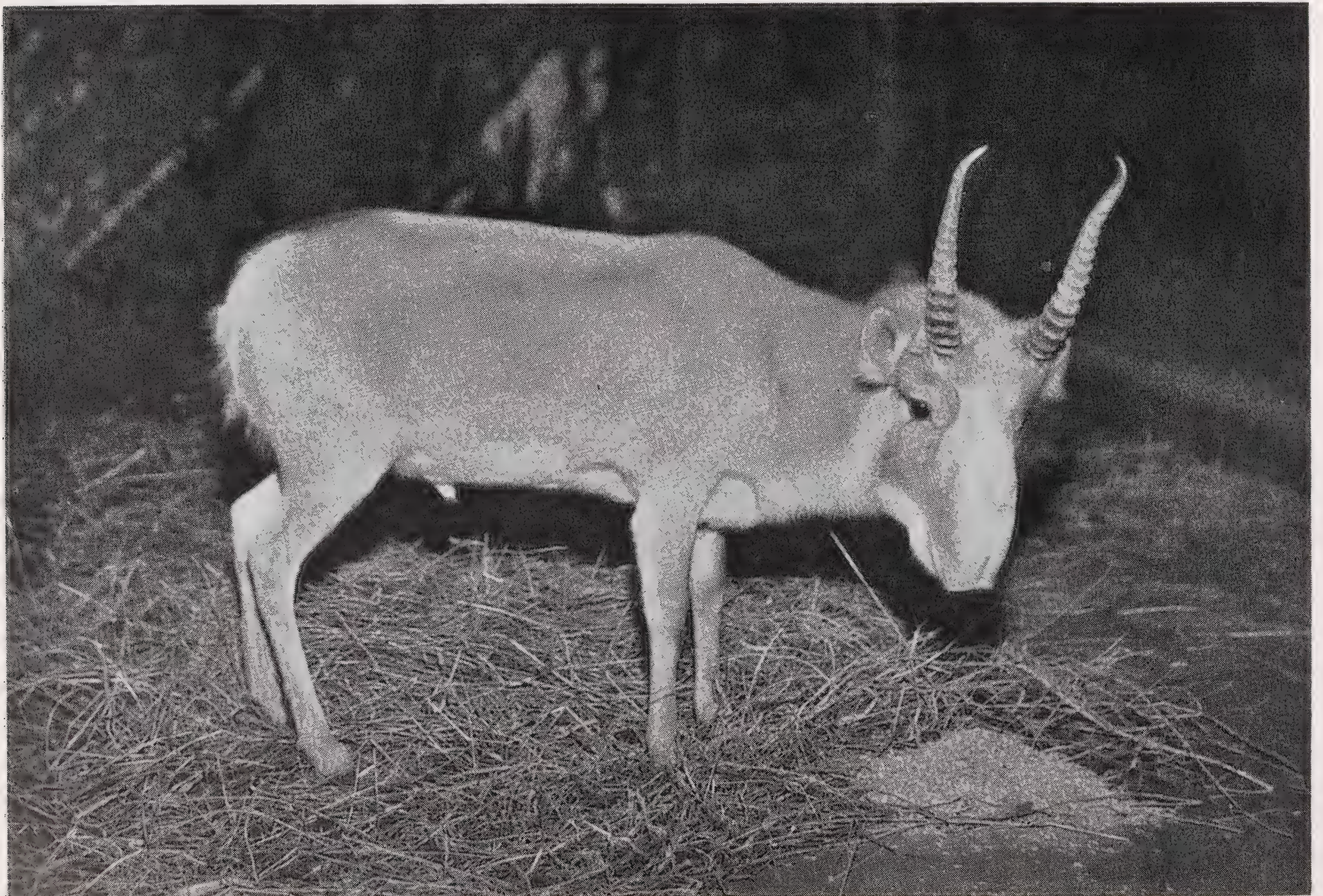
The animal is known to the roving Mongols of central Asia as the "burkark," meaning stooper. The fitness of this name was brought home to us in an amusing way. Soon after our saiga was placed on exhibition a newspaper photographer spent an exasperating amount of time and energy in trying to induce him to assume a head-up, alert position. But all efforts were unavailing and he had to be satisfied with a seemingly unnatural pose that was actually the only natural one. Undoubtedly, the native name has come into use because of the animal's characteristic habit of holding the head low, almost never above the level of the shoulder, and moving along with a slinking, stooping gait.

The saiga is distinctly a migratory animal. It is not equipped to withstand the harsh winters which prevail over the sweeping plains where it spends the summer season. So the coming of fall finds the herds heading toward the south, where the snowfall is not so great. There they spend the winter months in protected valleys. The young are born in early spring. With the melting of the snows the bucks begin their northward trek back to the open plains, soon to be followed by the does and their young who reach their summer ranges by the end of May.

The saiga comes to us as a modern survivor of the ancient animal population of Europe during the Pleistocene. At that time it was widely distributed over the plains of Europe and southwestern Asia. The western portions of its range extended into Great Britain and southern France. It probably held its own fairly well through time and climatic changes until after the Middle Ages, when the increasing population of Europe resulted in the settling of new

and virgin territory. Later on, following the development of modern transportation facilities, the western portion of its range was curtailed more and more. In modern times, as recent as 150 years ago, the saiga was fairly common on the plains of Poland. During recent years a few herds were to be found in southwestern Russia, where they are now rare, and the saiga today is found in numbers only on the steppes of southwestern Siberia.

The inaccessibility of the saiga's native plains was perhaps the chief reason for its rarity in zoological parks. The modernization of Russia's transportation system and the opening up of previously undeveloped territory will bring us other specimens but it will also eventually cause the practical disappearance of the saiga as a wild animal. Like our American bison it is a creature of the vast open spaces but, unfortunately, dependent upon territory destined for human occupation and of late years rapidly being settled or spanned by railroads.



The Mongols of central Asia call the saiga by a name that means "the stooper," because of the animal's habit of carrying its head in a stooping position, as is shown by this characteristic pose.

Slowly the Lungfish Gives up Its Secrets

More Is Being Learned in the Laboratory about the Strange Physiology
and Habits of This Air-breathing Fish

CHRISTOPHER W. COATES

New York Aquarium

AS exhibits worthy only to satisfy the curiosity of the public about the existence of a true fish that has the ability under certain conditions to live for years outside of water, lungfishes from Africa and South America have long since ceased to be novelties of the first class at the Aquarium. Off and on, they have been displayed in small, shallow tanks many times since the first one was brought up from Africa about thirty years ago.

But behind the scenes—in the Aquarium's laboratory and in the laboratory of the New York University College of Medicine, in the research rooms of Yale's School of Medicine and elsewhere—lungfishes still hold exciting prospects for further investigation and important discoveries. Any living creature so specialized that it apparently defies the operation of laws that govern the vast majority of other animals is certain to be of interest to scientists in many fields. What more fascinating problem for the student of metabolism than the functioning of a fish that during long periods of aestivation consumes *muscle* tissue instead of, as in most animals, stored fat? How can cancer research overlook a fish that abundantly produces melanomas, or colored cancerous growths? And what a find for investigators of the kidney functions—a fish that at certain times permits a concentration of urea in its blood in quantities five hundred times greater than would be poisonous for most other vertebrates!

In the working out of some of these problems the Aquarium has several times played a part. At the present time only two lungfishes are on actual exhibition, but in laboratory racks behind the exhibition tanks are long rows of small tanks half filled with foul, muddy water, and in these are stored lungfishes of all sizes awaiting the

orders of the researchers. Some hint of the practical problems of maintenance, handling and shipping the fishes was given in the motion picture presented by the Aquarium at the Annual Meeting of the Society in January.

Visitors to the Aquarium who have watched the changing exhibits of lungfish over a period of years have, at one time or another, seen most of the known species. There are, in fact, only three living genera—one genus in Africa, one in Australia and one in South America. The great tropical portion of central Africa supports three species: *Protopterus aethiopicus*, *P. annectens*, and *P. dolloi*. Australia's single species is *Neoceratodus forsteri* of the Bennett and Mary Rivers in Queensland, on the east coast of the continent. The South American representative, *Lepidosiren paradoxa*, is fairly frequently brought to New York by animal and fish dealers from the equatorial belt of Brazil.

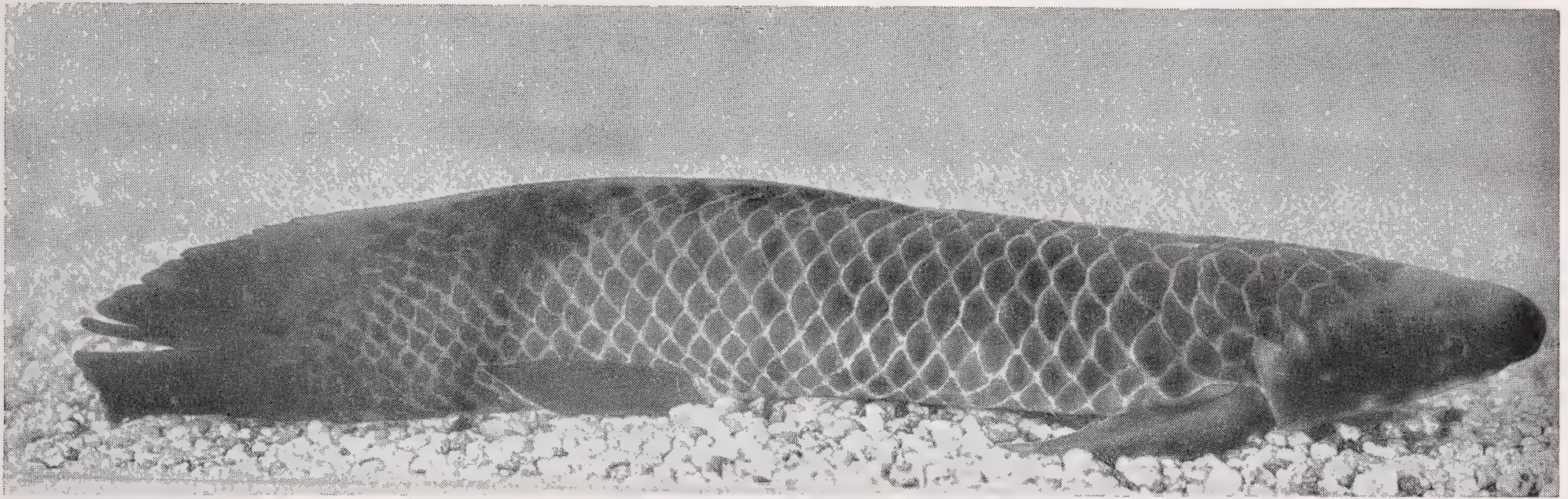
It seems very doubtful if the Aquarium will ever, or at least for a long time to come, be able to exhibit a specimen of the Australian species, for it is rigorously protected by the Australian government and its capture and export is forbidden. Compared with the broad range of the African and South American species, *Neoceratodus* is closely restricted to a small area in Queensland, and the encroachments of civilization have cost it still more ground. If the species is to be kept in existence, a strict protection is necessary. Nevertheless, *Neoceratodus* is not entirely unknown in this country; a specimen was exhibited at the Zoological Park late in 1920, and some years ago the Chicago Aquarium sent an expedition to Australia and by special arrangement with the Australian government was permitted to take a few specimens. Only one reached the United States alive, however, and it was subsequently reported to have died.

These five species of lungfish are generally

Most of the illustrations accompanying this article are from the New York Aquarium motion picture, "Aquarium Highlights," taken by S. C. Dunton.



(Upper). *Protopterus annectens* immediately after taking a mouthful of air and before swallowing it. (Lower). Head of *Lepidosiren paradoxa*. The large black area is a typical colored cancerous growth.



This Australian lungfish, the only one ever exhibited here, came to the Zoological Park in 1920. It was 19 inches long. It was exhibited in the Reptile House and ate voraciously of chopped beef and small frogs.

supposed to be the sole survivors of a much larger group of related animals that were able to breathe by means of lungs when their natural watery element deserted them sometime in the dim evolutionary ages. Their immediate relatives died off, however, something like fifty million years ago, according to the evidence of fossil remains found all over the world—on every continent. “Primitive” fish the lungfishes are called, a term that refers to their form, their internal characteristics, their curious lack of specialization in some respects and their most remarkable specialization in others. Through such fishes the scientist may gain an insight into conditions that prevailed when the world was in process of division into its present domains of land and water.

It does, of course, belong to the realm of imagination to picture the details of the transformation that went on when the swamps and the shallow waters dried up and teeming life was compelled to adapt itself or die—but adapt itself the lungfish did, with such effectiveness and efficiency that no further major adaptation became necessary to its survival through the millions of years to the present day. Here was a water-living fish, a resident undoubtedly of swamps and shallow places, that found its swamps drying into mud and sun-baked clay; its shallow places settling into swamps. To those radically changed conditions it responded by the development of organs for breathing free air—and then it continued to live exactly where it had before, in swamps that perennially dried up and shallows that periodically disappeared. As long as there was water, the lungfish found it-

self completely at home and at liberty to move about in search of food, but when there was no longer water available, as may be the case for months or even years in some parts of its present habitat, only liberty of motion and external sustenance were denied it; life could still go on, because this fish had found the ability to lie dormant and take oxygen from the air, food from its own tissues.

It is only in recent years that a good many of the details of the way of life of the lungfishes have been discovered. Textbooks and technical works on fishes, indeed, of only a few years ago, have been found inaccurate in some of their observations. Much, of course, remains to be worked out by scientists in the laboratory and in the field, but in general the life history has been demonstrated.

The three species of the African genus, *Protopterus*, are extremely closely related and it may be that they are—or rather were within comparatively recent years—one species with small differences due to geographic distribution. In respect to their living and the necessary care for their well-being they are identical. Generally speaking, the classification into three species is now made only on the point at which the long dorsal fin commences; in *aethiopicus* it begins at about the middle of the body line; in *annectens* it starts forward of the mid-body, and in *dolloi* just behind the middle. It may be that some day lungfishes will be induced to breed in captivity and taxonomists will be astonished to discover that babies with dorsal fins beginning in all three positions can come from the same nest of eggs.



(Upper). Putting the lungfish into soft mud. (Lower). The hardened cake of mud, with the lungfish inside.



(Upper). Cross-section of mud block. (Lower). Transverse section. Air hole is at upper edge of the block, shred of membrane adhering at bottom of burrow.

We know that lungfishes are inhabitants of what may, by courtesy, be called fresh water and that they cannot long survive immersion in salt water. "Fresh" water, however, is only a term to distinguish it from salt, or sea water, for anything more fetid and foul than some of the waters in which lungfishes have been found is hard to imagine. Indeed, the fish not only enjoys the murky waters of swamps and muddy streams, but demands it. Experimentally we have tried keeping lungfishes in ordinary New York City tap water—a water that, however it may have been chemically treated for human consumption, is perfectly satisfactory for a great many fresh water fishes. Within a few days lungfishes kept in clean tanks of clean tap water became covered with skin eruptions—which disappeared when they were dropped back into tanks of dirty water.

That experiment, however, was an inadequate preparation for the surprise of investigators when they found that lungfishes that could not survive New York City drinking water could live with apparent ease and health for long periods in distilled water from which not only every impurity but every presumably necessary salt had been removed.

In their native Africa, Australia and South America some lungfishes are found in small streams that seldom, if ever, go completely dry, so that fishes perhaps for years at a time never have to call upon their ability to aestivate. Coming to the surface at frequent intervals to take in gulps of air, they pursue their food in the water and never voluntarily hole up in the mud for a rest. It is doubtful if the Australian species can still aestivate efficiently, but specimens are not available for laboratory demonstration of this.

But African or South American species that happen to have chosen swampy places for their home, or streams that are stilled in the dry season, are often called upon to exercise the special ability that they gained in their strangely changing world of millions of years ago.

When the dry season comes and the waters sink lower and lower, the lungfish burrows head first into the soft, clinging mud of the bottom. Its narrow, flabby fins are probably useless in this operation, as they are in everything else, for they bear no internal bony structure and could scarcely help the fish to push its way

eighteen or more inches under the surface of the mud.

Even under the torrid sun of Africa swamp mud dries but slowly down to any considerable depth, and during the first period of its aestivation the lungfish is able to push its way to the surface at frequent intervals to seize a supply of fresh air. But slowly, gradually, as the surface of the mud dries and hardens, the narrow opening the diameter of the fish's body is constricted by the drying and the movements of the fish until at last there is only a breathing hole scarcely larger than the diameter of a lead-pencil.

Half an inch below the surface the tube broadens to the thickness of the fish's body or even wider. Down it runs, fairly straight for a few inches, and then it turns to one side and ends in a sack-like cavity just large enough to contain the singly-looped body of the fish.

From sections of these burrows that have been examined, it appears that the lungfish does not settle down quietly to complete aestivation until all possibility of remaining active and getting fresh air near the surface has been precluded by the hardening of the mud. While it is still very soft the fish will work its way to the surface and breathe, and as the topcrust hardens it still struggles upward as far as the iron-hard mud will permit, and often makes one or two attempts to push its way to the top by branching off from the hollow tube that was created when it entered the mud. At last, with all possibility of reaching the surface cut off, the lungfish settles down in the bottom of the cavity for the duration of the drought.

Only in one particular way does the fish settle itself for its long sleep. With the head pointed upward, its body loops in the middle and doubles back, so that the thin tail covers and protects the eyes. For some reason that has not yet been discovered, lungfishes that attempt to aestivate without covering the eyes with the tail have invariably died.

Three functions, among others, become extremely important at this stage. The fish must continue to breathe, it must have food and conserve its bodily supply of water, and it must take care of the body wastes.

Microscopic sections of the skin of the lungfish show comparatively enormous mucous cells near the surface. These come into operation and



(Upper). Removing the final casing of the fish's living tomb. (Lower). Where the membrane folds into the mouth.



*(Upper). The tail is always folded over the eyes and head during aestivation.
(Lower). Unfolding the fish.*

around the folded body they secrete a film as thin as cigarette paper but absolutely impervious to water and air—thus to evaporation. The film covers every bit of the body, forming a kind of sack, and around the mouth turns inward for a short distance so that the mouth is the only external opening through which moisture might be lost.

Very little moisture disappears through exhalation, however. When the mud is soft, the lungfish comes to the surface perhaps as often as every twenty minutes to take in air, but when the mud hardens its breathing is reduced to one gentle expiration and inhalation about every two hours.

There, enclosed in a sack of its own contriving, the lungfish lies without food or water. Theoretically its method of fasting is contrary to all precedent and custom. Most animals that hibernate or aestivate keep the slow fires of their metabolism burning by feeding upon their own stored fat, but not so the lungfish. Its muscle tissue, generally the last to be consumed in a starving animal, is the source of its food. For the first month its rate of consumption is terrific—about one-seventh of the fish's weight is consumed in that period. But thereafter the consumption of tissue drops off sharply and at the end of two years of continuous aestivation, the rate of tissue loss is so small that it cannot easily be measured.

It appears, however, that over a long period of aestivation, the fish might lose as much as one-half of its weight. What the limit of this self-consumption actually is, nobody knows at present. Lungfishes have been kept in blocks of hardened mud in Dr. Homer W. Smith's laboratory at New York University Medical College for more than four years—and have come out of them thin, emaciated, hungry, but perfectly healthy.

The problem of body wastes would, in most creatures, be a serious one for a dormant period that might last not for months, as in the case of such northern mammals as bears, but for years. No wastes can be thrown out of the body, of course, because of the enveloping film, and no water can enter to dilute the wastes, both because of the film and because all moisture has been baked out of the mud surrounding it. The lungfish kidney, therefore, has been specialized to such an extent—and this was the feature that so interested Dr. Smith that in 1931 he made a

trip to Africa and brought back nearly a hundred lungfishes for laboratory examination¹—that it efficiently separates the body's content of water and urea, stores the urea, and permits the water to be used over and over again. Urea continues to increase, of course, so long as tissue is being consumed, and eventually after long aestivation the urea concentration may grow as high as 10,000 parts in 1,000,000. In most other vertebrates, toxic uremia sets in when the concentration is about 20 parts in 1,000,000.

But, strangely enough, within an hour after a lungfish has come out of aestivation and has been placed in water, the greater part of its urea has disappeared, and within twenty-four hours the concentration is back to about "normal."

The return of the fish to its watery habitat occurs when the rains come and soften the mud. Water, of course, runs down into the cavity through the air-hole to the surface, and finds its way into the fish's mouth. At that signal that life is about to begin again, its bodily functions begin to change and as the mud softens, the fish, in danger of drowning, breaks out of its filmy envelope and pushes back to the surface by way of the tube through which it went down.

Thereafter it begins to feed voraciously on worms, insects, crustaceans, frogs and the small life of the roiled waters.

In the Aquarium we have had success in keeping lungfish alive on strips of raw beef heart with earthworms and night-crawlers as occasional variations. A healthy eighteen-inch lungfish will consume a quarter of a pound of meat in two days.

So far we have never been able to induce a lungfish to breed in captivity. However, it is known that in the wilds they build nests of two or three feet diameter in the surface of the mud, and that the male guards the eggs which the female deposits there.

It was very soon discovered, when the first attempts were made to bring the fishes out of Africa and South America, that they are fierce fighters and that two cannot be placed together without fatal results for one or both. In fighting they go after each other's fin filaments and these are soon torn or bitten off—only to regrow within two or three weeks. The fish's regenera-

¹ Smith, Homer W. Kamongo, Harper & Brothers, New York, 1932.

tive powers are really remarkable and we have seen one specimen that had lost the rear six of its thirteen inches of body without any apparent discomfort. Within three or four months the severed parts had grown again, and eventually the fish attained a length of more than eighteen inches. Of course, only the tail, and no internal organ, was involved in this case.

Dr. Smith brought 96 lungfish from Africa in 1931 for experimental purposes. His difficulties began in the field when he discovered that fish transported from the place of capture to his base camp in pails of water generally drowned before they arrived, waterliving creatures though they were. In coming to the surface for air, with mouths wide open, they were at the mercy of the small waves created by the motion of the pail and usually they swallowed a mouthful of water instead of air. Lungfish dumped in a sack and transported dry, on the other hand, lived well.

In the last year or two the problem of creating a satisfactory mud for their aestivation in the laboratory was undertaken by the

Aquarium. Ordinary New York State clay was not satisfactory: the lungfish refused to curl up in it. Finally a mixture was created of finely sifted topsoil, mud that had settled to the bottom of tanks in the Aquarium and was, of course, largely composed of fish wastes, peat moss, aquatic plants, and grass roots.

This composite mud, an approximation of the conditions that it was supposed would obtain on the bottom of a tropical pond, proved highly satisfactory, except that occasionally it was made too soft and the fish in curling up came in contact with the bottom of the glass container. In such cases, death always occurred. A technique was finally worked out whereby the container was first lined with stuff mud, then with coarse netting, and then with another inner layer of stiff mud. After this was allowed to dry the soupy mud suitable for aestivation was poured in, and the lungfish introduced—to its complete satisfaction. By such means Dr. Smith's laboratory has been able to "hole up" a desired number of its specimens and to preserve them alive apparently indefinitely.



The fish is returned to the water curled up—very much as it came out of the mud. It straightens out within a few minutes and at the end of 24 hours does not seem to suffer from any muscular stiffness.

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NOTES FROM THE ZOOLOGICAL PARK

Dr. Charles V. Noback

Dr. Charles Victor Noback, veterinarian at the New York Zoological Park since 1926, died at the Presbyterian Hospital in New York City on Saturday, January 16, after a week's illness.

Not only was his death a painful personal shock to his associates, but it was a real loss to science, for he was ardently devoted to research and had accumulated a large amount of data on the pathology of animals which, sifted by his incisive mind, would have resulted in many important contributions. At the time of his death he was engaged in writing a most complete report on the development of the Park's female gorilla, Janet Penserosa.

Some of his publications and lines of research at the Zoological Park were on seasonal changes in antlers, direct bone formation in antler tines, and on the digital epiphyses and carpal bones in the gorilla.

Born in New York City on March 2, 1888, he received the degree of Doctor of Veterinary Medicine at Cornell University in 1911 and in 1925 took his degree of Doctor of Philosophy there. In 1911 and 1912 he was veterinary inspector for the Bureau of Animal Industry of the U. S. Department of Agriculture and subsequently, until 1920, was veterinarian working on the infectious diseases of animals in the New York City Department of Health.

In 1920 he went to Colombia to organize work in tropical veterinary diseases and as pathologist and consulting veterinarian he spent four years there, working at the Laboratory of Hygiene in Bogota and teaching in the Veterinary School of the National University.

In 1925 and part of 1926 he was bacteriologist for the New York State Department of Health, joining the staff of the Zoological Park in the latter year.

Dr. Noback was a Fellow of the New York Zoological Society, of the New York Academy of Sciences and of the American Association for the Advancement of Science. He was past president of the New York City Association of Veterinarians, president of the Alumni Association of the New York State Veterinary College, and a member of the American Veterinary Medical Association, the New York State Veterinary Society, the American Association of Physical Anthropologists and the American Society of Mammalogists.

The Arum Frog

South Africa has a great variety of frogs and toads. They range in size from one of the smallest species in the world, not much larger than a common fly, to the seven-inch bull frog that quacks like a duck. Some of the species are entirely aquatic, swimming with the agility of fishes and enabled to do so by means of extremely broad hind feet and fan-like webbing.

One of the most attractive of the smaller species is the arum frog, *Hyperolius horstockii*. The common name of this frog was applied because of the habit of the species to lurk among arums, a lily-like plant that grows on the Cape Flats. The frog has dilated finger tips or "suckers" and can make its way over the leaves, even hiding in recesses of the blossoms. When perched on a stalk it is very difficult to detect, as its body is elongate, the feet are tucked well under it, while the eyes are half closed. The upper body hue is brownish or olive and mimicry is further carried



The tiny African golden frog, only about an inch and a half long, but a hearty eater of small insects.

out by longitudinal markings. The underside of the body is white and the legs are in marked contrast, being of golden hue.

On a recent return of the *S.S. City of New York*, Mr. Albert M. Vida, the wireless operator, brought us a dozen of these attractive frogs, among a series of particularly interesting reptiles and amphibians. Mr. Vida frequently adds to our collection of South American specimens.

The arum frog begins life in the water as a minute tadpole, which soon transforms. The adult is about an inch in length. There are other species of *Hyperolius* found to the northward. One has particularly ornate markings of brown and green and is called the marbled rush frog. Clinging to a stem, it is said to be extremely difficult to detect as it blends with the colors of specific vegetation that forms its lurking places.—R.L.D.

Starling Visitors

The Zoological Park was visited by an enormous flock of starlings late one afternoon during the third week in January—a flock that seemed to contain most of the starlings that make their roosting headquarters in the northern part of New York City.

Normally flocking birds, starlings like to roost in winter in protected corners and crevices, and thousands of them have their regular roosting places in New York City. Early in the morning they fly north to the open fields on the outskirts of the city to feed on berries, such in-

sect remains as they can find, and any bit of green on the ground—grass, narrow-leaved plantain, and so on. Before dusk they return to the city where thousands of them may have established community roosting places around the eaves of two or three apartment houses.

Usually they fly over the Park in small groups of half a dozen to a hundred, but on the evening when the large flock was observed there were hundreds, if not thousands, flying together. Presumably they had been feeding close in and had turned southward simultaneously, pitching down in the trees of the Park before breaking up into smaller groups to proceed on to the roosting places.

Spring Weather

The unseasonable weather of December and January has had a disturbing effect on the plant life, if not on the animal inhabitants, of the Zoological Park. Under the influence of mild winds, spirea bushes in the Park appeared by mid-January about to burst into leaf, and a bat was observed on a January afternoon, flitting about the Park in search of early insects.

With few exceptions, all animals that are normally kept indoors during the winter months, have not been turned out, even on the mildest days, because of the danger of sudden changes in temperature.

The mild weather has kept the Park's population of visiting black ducks at the lowest point in many years, about 700.



When starlings invaded the Zoological Park in a huge flock on their way to their regular roosting place, thousands of birds settled in the trees and gave them the appearance of being in leaf again in mid-winter.

PRESENT DAY MAMMALS

By CLAUDE W. LEISTER

GENERAL readers as well as students in zoology and biology classes who have often been puzzled by the relationship of animal groups will find this an invaluable reference work—a handy book to have in one's general library, and a useful adjunct of textbooks.

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BULLETIN

NEW YORK ZOOLOGICAL SOCIETY



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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

Annual Membership in the Society is \$10, renewable annually. Life Membership may be obtained for \$200. A contributor of \$1,000 becomes a Patron; \$2,500 an Associate Founder; \$5,000 a Founder; \$10,000 a Founder in Perpetuity, and \$25,000 a Benefactor.

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Application for Membership may be given to the Director of the Zoological

Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 101 Park Avenue, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



The skunk is a good friend of the farmer, for the insect millions, fruit, berries and injurious small mammals are its chief food.

BULLETIN

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The Value of Predatory Mammals

A Few Words in Defence of "Vermin," Whose Destruction Defeats the Very Purposes for Which It Is Designed

W. J. HAMILTON JR.

Cornell University

A BELATED effort is now being made to restore and conserve the wild life of our continent. The alarming decrease of game, fish and fur-bearing species has caused grave concern to the custodians of wild life, and much effort is being expended to bring back these species. Research projects on fundamental wild life problems have been started in a dozen different States, and the results of these have dispelled many popular notions. But one persists—the mistaken premise that predatory species, "vermin," are not compatible with the natural increase of game species. In spite of enlightening researches to the contrary, the biased opinions of sportsmen and even game officials place the furred predators in a derogatory light. Predators are ruthlessly destroyed in many States on the assumption that their decrease will witness a revival of game. Alluring bounties, encouragement of vermin campaigns, and the indiscriminate slaughter of predators has continued for years, yet there is little evidence that such wanton killings have increased our game species.

To question the wisdom of this destruction, or the general encouragement of vermin campaigns, might well be considered rank heresy. The time-honored prejudices of sportsmen are seemingly impossible to surmount. Most hunters generally lose sight of the fact that since time began, flesh eaters have preyed upon plant eaters to the mutual benefit of both races. Predatory species are a check to the undue increase

of herbivores; without them the herbivores must increase until their food supply is exhausted, when they speedily starve. Some may argue that the disturbance of the environment by man has changed natural conditions to such an extent that predator control must be practiced. There are many instances which show such a thesis to be untenable. One will suffice. In the Kaibab National Forest of Arizona, the wolves and mountain lions were largely destroyed by man. The deer, relieved of their natural enemies, increased to such an extent that their food supply failed and in consequence many died.

Predatory species are numerous in the bird and mammal world; we shall confine our remarks to four widespread predatory mammals, namely the coyote, fox, skunk and weasel. Except the coyote, these forms are found throughout the United States. The coyote, while restricted chiefly to that area west of the Mississippi, is rapidly extending its range. Before discussing the relationships of these four animals to game species, it will be well to consider their food habits, for this will best reflect their importance to game.

What Do Predators Eat?

A recent study¹ of coyote food in Wyoming by the Federal biologist, O. J. Murie, is overwhelmingly in favor of the coyote for the region studied. In the Jackson Hole country,

¹ U.S.D.A. Circ. 362.

where elk, deer and mountain sheep thrive, the chief food of their potential enemy, the coyote, was found to consist primarily of small rodents. Field mice, pocket gophers, hares and marmots make up the bulk of the food, while insects, chiefly grasshoppers, contribute in no small way to the diet. The study did not reveal that the coyote may be considered a serious menace to

cused of being blackguards; animals which have no place in the scheme of game restoration. Most sportsmen regard them as "vermin" to be killed at sight.

The food of the red fox has been studied rather well in the past few years. Investigations² in the mid-west, Michigan, New England, New York and Virginia are all in essential

agreement. The studies indicate that the fox feeds chiefly upon fruit and berries, small mammals, chief among which are mice, carrion, insects and an occasional bird. I do not doubt it prefers a tender grouse to a half dozen mice, but the fact remains that mice are far more abundant than grouse, and much easier to catch. A few years ago a prominent game official, after admitting his State had made no scientific inquiry on the food habits of the fox, categorically stated that a game protector, through cursory field examination of dead foxes, concluded that 90 per cent. of the food of the red fox consisted of grouse and rabbits. It is difficult enough for the trained biologist to analyze and to interpret his findings in food habits research. How can we expect a tyro to judge so readily of the remains found in



This chart, prepared by the author, largely absolves the skunk of the charge of being a heavy destroyer of game.

the larger game species such as elk, deer and mountain sheep, although a number of these animals are undoubtedly killed by the coyote. It cannot be denied that coyotes do kill a certain amount of livestock and poultry. On the other hand, the coyote's destruction of noxious rodents which seriously compete with livestock and big game for the range will offset their predatory habits. According to Murie, less than 12 per cent. of the food eaten by the coyote may be charged against this wild dog. Similar investigations of western scientists are in accord with the findings of Murie.

The several species of foxes are widely ac-

stomachs of predatory animals? Yet the statement of this game official was widely circulated.

The skunk has long been held in ill repute by sportsmen. The antagonism of hunters cannot be attributed to its mephitic odor, but rather to the well-nigh universal assumption that it lives only to dine upon quail, pheasants, rabbits and other game. This attitude is reflected in the game laws of more than a dozen States which give the skunk no protection. It cannot be denied that the skunk does kill game upon occasion, but extended investigations, based upon examinations of several thousand

² *Jour. Mamm.* Vol. 14, no. 1; vol. 16, no. 1 and 3.

stomachs and droppings of these animals, prove them of great value to the agriculturist. The chief food of the skunk are the insect millions, fruits, berries and the small animals which everywhere abound. The first legislation in New York protecting the skunk was passed at the insistence of the hop growers, who recognized the worth of these fur-bearers in controlling the grubs of the hop weevil, an insect which at one time threatened the very existence of the hop industry.

It is seldom that we hear a good word for the weasel. Its general physiognomy implies a lust for carnage in keeping with the long established myths of blood sucking credited to this species. But weasels do not suck blood habitually. Like other flesh eaters, they consume quantities of flesh, fur and bone. This trait makes it not difficult to determine, by stomach analysis, the food habits of the weasel. An analysis of several hundred weasel stomachs in New York, secured chiefly during the fall and winter, proved that more than 95 per cent. of their food consisted of small animals, chief

among which was the ubiquitous and destructive field mouse. Less extensive study of the spring and summer food indicated it was little different from that taken in the winter, although we find weasels including insects and earthworms in their dietary at this season. A weasel den bordering an Iowa swamp produced the remains of black-birds and a quantity of ground squirrels.

A weasel raid on the poultry house is widely publicized; widespread destruction of chickens by the rat hardly elicits comment. Yet—weasels are the inveterate foe of rats, large numbers of these rodents being destroyed by these useful little marauders.

Interrelationship of Species

Few non-scientific persons realize the interdependencies which exist within the organic world. No animal or plant can live unto itself alone. The immortal Darwin was the first man to make clear the intricate interconnections of Nature, which we commonly call the Web of Life. Darwin's classic example showing the connection between cats and clover is known to all biologists. It is not difficult to find similar examples anywhere. A few instances showing the relationships which exist between predatory mammals and game species will be given.

Dr. A. K. Fisher, an outstanding authority on American bird and mammal life, relates the following story:

An extensive marsh in northern New York harbored great numbers of ducks, rails, turtles and other aquatic life. The snapping turtles



The weasel is an inveterate destroyer of rodent pests, such as the ground squirrel that spreads the dreaded plague, destroys crops and attacks young game birds.

deposited their eggs in great numbers in the sands of an old beach bordering the swamp. These delicacies attracted the skunks of the neighborhood, and their feasts so reduced the total output of eggs that only a small percentage of the young hatched and reached the protection of the water. As time went on, conditions changed. Skunk fur became fashionable, and commanded a good price. Within a short time the skunks almost disappeared. When this check on their increase was removed, the snapping turtles hatched in great numbers. When their numbers had been properly controlled by the destruction of a large portion of their eggs, their food supply was adequate, but when their numbers greatly increased, the supply proved insufficient.

Finally, through force of circumstances, the turtles added ducklings to their fare until the few ducks that refused to leave the marsh paid the penalty of their persistence by rarely bringing to maturity more than one or two young. At last, there came about a depreciation in the value of skunk pelts, with a corresponding loss of interest on the part of the trapper, so that the progeny of the surviving skunks congregated at the old beach and devoured the eggs that had enjoyed a brief period of prosperity. This, coupled with the destruction of the turtles by market hunters, attracted more ducks, and the old marsh became a populous center for game birds.

It is well known that foxes, raccoons and opossums likewise enjoy the eggs and young of turtles.

The British naturalist, Charles Elton, cites³ an illuminating instance of the effect on game of wholesale predator destruction. In Norway there is a bird called the willow grouse. In early years these willow grouse used to multiply periodically and every three or four years each sportsman got a fine bag. After these good years, the grouse used to die off from disease because they had become so crowded. At the same time, the Norwegians had a great drive to wipe out birds and animals of prey—eagles, foxes, martens and other fur animals. As the birds and predatory mammals have become scarcer, it has been noticed that the epidemics among willow grouse have become worse and worse. Instead of more and better willow

grouse populations having been produced by protection, the stock has become progressively more diseased. It was suggested that the reason for this greater mortality was this: when a grouse became sick with coccidiosis, it weakened and flew less readily, and was thus easier to catch. As a result, in the old days the predators used to catch the sick ones more readily than the healthy birds, and so prevented disease from becoming too severe, except after the birds had become very abundant.

While making a detailed study of the habits of the ruffed grouse in Minnesota, Dr. Ralph T. King discovered that not all the animals commonly suspected of being hostile to the grouse actually are. On the other hand, those which have been least suspected often do the most damage. This keen observer found the chipmunk an enemy of the grouse. The little striper evidently thinks grouse eggs make fine marbles. It rolls them from the nest, plays with them and hides them, usually without breaking the eggs. On one occasion King found a grouse nest with twelve eggs. Next morning they were gone. Suspecting a chipmunk, he searched about and found all twelve.

Now the fox, while fond of grouse, finds it much easier to dine on chipmunks. Not only are they far more numerous, but they cannot take to the air as can a grouse when pursued. That foxes can and do destroy chipmunks is amply demonstrated by finding their remains in the stomachs and droppings of foxes. If we study the simple food chain below, we are at once made aware of the importance of considering these interrelationships: The chipmunk is a predator of grouse, the fox is a predator of both chipmunks and grouse. But the chipmunks are far more numerous than foxes, perhaps 200 times as numerous in a given area. Inasmuch as the fox destroys more of these ground squirrels than grouse, it might well be argued that the fox is not only entitled to a few grouse, but further, an actual asset to the grouse by its destruction of a far more potentially dangerous predator of the game bird.

Recently two Utah game managers reported⁴ on their sage grouse survey. They relate one instance of ground squirrels killing young sage grouse, leaving only three or four chicks from a covey of fourteen. Ground squirrels also prey

³ Exploring the Animal World, p. 89.

⁴ Utah Agr. Exp. Sta., Misc. Publ. 10, 1933.



An Adirondack trapper with his catch of fox, coon and skunk. The fur catch of the nation has been estimated to yield the trappers as much as \$60,000,000 annually.

Photo by E. J. Dailey

upon other game species and poultry. Coyotes and desert foxes take an appreciable toll of these ground squirrels and thus lessen predation upon desirable birds. Inasmuch as ground squirrels are several hundred times as numerous as the large predators, might we not rightly argue that these fur-bearers are an actual asset to the game they are accused of destroying?

The lessons here pointed out are obvious. The examples just cited are simple and easily followed, but others are more complicated and sometimes difficult to fathom. Shrews, small mouse-like creatures which abound in suitable cover throughout the country, have been known to destroy the eggs of ground-nesting birds. Some of these bird species have eggs as large as those of the quail. The bob-white quail is America's most beloved game bird. If it is shown that shrews are predators of these birds, through destruction of their eggs, how can we hope to control shrews other than by the en-

couragement of predatory species, which are known to destroy large numbers of these little mammals?

Value to Game Species

We have seen that wholesale destruction of predatory species does not often accomplish the anticipated end results of favoring game increase. The disturbance of Nature's equilibrium sets in operation a host of unlooked-for consequences. Each animal in an ecological complex is closely related to its neighbors, the whole making up an elastic web which, if but slightly disturbed, makes for great, and frequently grave, consequences.

The reader might well inquire at this point

A mouse-hunting red fox. Foxes kill large numbers of mice, rabbits and other pests, but are themselves widely hunted for sport.



what animals should be classed as vermin. The answer—perhaps none. There are, however, a host of animals, usually of small size and widespread abundance, which seriously compete with game species, both directly by vying for the same food and killing the game, and indirectly by harboring disease organisms which find susceptible hosts in desirable birds and mammals. Among these lesser but nevertheless important species we might mention various small rodents, such as the brown and cotton rat, ground squirrels, certain mice and even insects. It has been demonstrated that fire ants cause a considerable loss to the quail population when they invade the newly pipped eggs of the bob-white and kill the hatching chicks. The quail studies of H. L. Stoddard in Georgia indicate the cotton rat is a serious competitor of the quail. Stoddard found the cotton rat population to number 40 per acre in broom sedge habitat at a certain season, whereas the quail population did not exceed one bird per acre. The cotton rat competes directly with the quail for food, and furthermore, the rats destroyed 3.5 per cent. of the quail nests. The natural enemies of the cotton rat are weasels, foxes, certain birds of prey and other "vermin." How much worse the quail destruction from cotton rat depredation might be in the absence of predators!

We can credit racial sanitation to the predators by their culling of the weak and unfit. By this weeding out of the undesirables, predators are responsible for a strong and alert race of game species. Far from being a misfit, the predator is an essential cog in the machinery which turns out healthy game. Almost never is it taken into consideration that game birds killed by the predator are better off dead. Individuals caught by predatory animals are frequently ailing, and their destruction minimizes the chance of infection being spread to their fellows. Predators have been called the sanitary brigade, an essential army which is ever at work eliminating the sick and unfit. They act as a check on overcrowding, thus preventing the pandemics which always accompany a marked increase in animal populations.

There are as yet many predator influences beyond our vision. In his "Game Management" Leopold cites an illuminating instance in which predators apparently had a desirable effect on a game animal. The normally distributed deer

herd on Vancouver Island, after the mountain lions and wolves had been killed off for their benefit, suddenly "huddled up" on a small part of their original range and overbrowsed it. Apparently normal depredation had some as yet obscure influence in keeping the deer distributed generally over the range. This is not cited as gospel, but rather as a suggestive influence which predators may have on their legitimate prey.

We yet know little regarding the relations existing between the mouse millions and game birds. What has been recorded indicates that the food of the little deer mouse is similar to that of the grouse. One mouse will store a peck of beechnuts or several quarts of clover seeds. Various small mammals, which frequently number more than one hundred to the acre, are potentially very important competitors of game birds for the available food supply. Fortunately their numbers seldom get out of bounds, for alert foxes, weasels and other predators are always ready to grab them up.

Other Predator Values

While most hunters are bird-minded, there exist a fair number who follow the hounds in quest of certain predators. Wherever the fox ranges, there we find hunters who spend long days afield, listening to the brassy notes of hounds ringing like bells on the frosty air. Even if the elusive one is not bagged, the hunter feels well repaid by a sight of Reynard. As autumn approaches, the great southern clubs organize their annual fox hunts. Masters of the hunt must look to northern trappers for their quarry. New York foxes, trapped or dug from their dens as cubs, are shipped to Maryland, Virginia and the Carolinas for these hunts. Still-hunting the fox finds much favor in New England. Not only foxes, but wildcats, wolves, coyotes, mountain lions and several other predators are eagerly pursued by a large fraternity of hunters who find in them an unrivalled sport.

The magnitude of the fur industry and its reliance upon wild caught fur-bearers can scarcely be realized by the uninitiated. Young men and old everywhere supplement their income by harvesting the fur crop. In 1928 it was said that the fur catch in the United States was worth \$60,000,000 to the trapper. Among the more important species contributing to this

rich harvest are certain predatory mammals, as the skunk, fox, opossum, mink, weasel, coyote and several others. Even in thickly settled districts these animals abound. Coyotes still invade the city limits of Denver, and fox tracks may yet be seen in the new fallen snow a few miles from New York. The members of many State conservation departments are alive to the value of these furred predators, and provide suitable protection for the various species while their fur is unprime. Other States, perhaps influenced by political pressure rather than by biological considerations, give little heed to the alarming status of these important species, and practice little or no protection for some of them. Indeed, not a few misguided officials have placed a price on the heads of such "vermin," and as a consequence, have squandered funds which might better have gone toward restoration and improvement of game cover.

Destructive rodents and insect pests share largely in the food of many predators. Ground squirrels, field mice and rats take a colossal toll of our crops, stored food and poultry. Rodents are responsible for the spread of typhus fever, plague and other pestilential diseases. The loss occasioned by these pests in the United States has been placed at half a billion dollars annually. Add to this the cost and effort of fighting these hordes (\$812,478 was spent in California in 1930 for rodent control alone) and we soon appreciate the necessity of reducing these rodent pests. Alert predators do much to keep these rodents in check. Instances of mouse plagues have been traced to the eradication of their natural enemies, thus permitting a rapid increase in the rodent population. A. B. Howell⁵ states that a number of years ago the foxes were purposely exterminated in Bohemia. Following this action there occurred such a severe epidemic among the hares of this area that it was necessary to re-introduce the foxes.

We might finally point out, among the many assets of predatory animals, their great recreational value. The so-called sentimentalists enjoy as much pleasure from viewing a bear as the hunter who bags it. The first glimpse of a wild fox among its natural surroundings is a red letter day in the life of a nature lover. Tourists to the west thrill to the sight of a

coyote, or rejoice in its melancholy howl on the night air. Cynics may scoff at the esthetic value of our wild animals, but such nevertheless definitely exists. This recreational value of our predators is reflected in the laws for their protection in the great national parks of the west. Here they may neither be hunted nor otherwise molested, and in consequence they become very tame, delighting visitors by their frequent appearance.

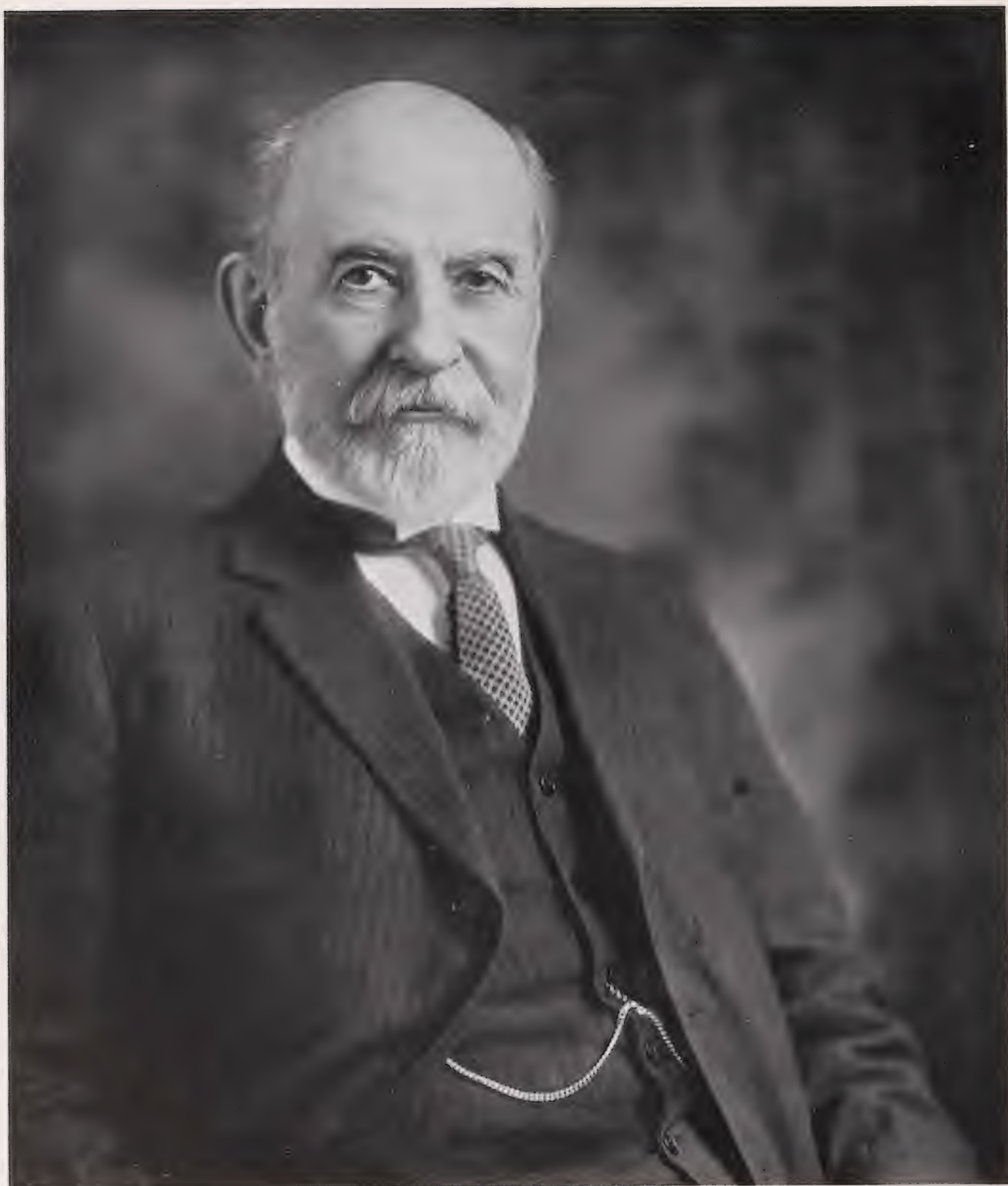
Bounties and Vermin Campaigns

Bounties are one of the oldest methods employed to curb the increase of supposedly undesirable species. The system is now employed in a number of States to limit the increase of certain predators. It has never been demonstrated that bounties have effectively reduced the species for which they were intended. On the contrary, a study of the system abundantly demonstrates its uselessness. Where bounty systems have been in favor for a number of years, the figures all too often indicate that the species on which a price is paid has increased. This may be due to an actual increase in the species, but more often it is the result of fraud. Animals caught in an adjoining State may be probated for bounty in the State which pays a bounty on them. Recently some Montana Indians treated the skins of full grown gophers with oil and lampblack and passed them off as coyote pups in an attempt to collect the two dollar bounty.

Vermin campaigns to rid the fields of "undesirables" are largely the efforts of uninformed fish and game clubs. Fortunately few foxes, weasels, skunks and other predatory beasts are killed, but the attendant publicity through press reports does much to put these animals in an unfavorable light with the laity. Such persecution of predatory species is all but baseless and is thoroughly unjustified in the light of cold scientific facts.

Control of certain predators may be justified about game farms; the poulterer may conscientiously kill the occasional marauder which harasses his flocks. But widespread condemnation of these valuable mammals, based on mere allegations and false premises, is to be deplored. We can no longer overlook their true significance, and the important role they play in nature.

⁵ Condor, May, 1930.



William Temple Hornaday

1854-1937

WILLIAM TEMPLE HORNADAY

IN the death of Dr. William T. Hornaday, which occurred on March 6 at his home in Stamford, Conn., the cause of wild life conservation has lost an outstanding champion. Although he called the last book he wrote "Thirty Years War for Wild Life," he had actually devoted an even longer span of years to the cause which lay nearest his heart. His campaigns for the better protection and preservation of wild life were for nearly thirty years carried on along with his exacting administrative duties as Director of the New York Zoological Park. After his retirement from the directorship on June 1, 1926, he continued his conservation work at Stamford.

Dr. Hornaday's fame rests in equal measure upon his career as Director for thirty years of the New York Zoological Park and upon his wild life conservation activities. A love of animals and of nature and the outdoors was an implanted trait from earliest childhood. He was born at Plainfield, Indiana, on December 1, 1854, the son of William and Martha Varner Hornaday. Later the family moved further west and settled in Iowa. Here he passed his boyhood working on his father's farm and in moments of leisure going out to hunt the wild birds and game that abounded on the Iowa prairies. But even while shooting for the family larder the game that was then so plentiful, he felt that there was something wrong in the killing of harmless creatures in unreasonable numbers and he resolved at that youthful age that he would at least not shoot any more squirrels.

To complete his education he went to the Iowa State College at Ames and while there became interested in the art of taxidermy. Deciding that he wanted to make the field of zoology his life work, he left college without graduating and came East to study at Ward's Natural Science Establishment in Rochester, N. Y. Here he rapidly perfected himself in all the branches of taxidermy and in 1874, when only twenty years of age, he was sent out on his first scientific collecting expedition. This trip took him to

Florida, to Cuba and the West Indies. Two years later Ward's Establishment sent him to South America, and in the fall of the same year he left on a collecting trip to the Orient, spending three years in India, Ceylon, the Malay Peninsula and Borneo. The experiences of these years were later recorded in his book "Two Years in the Jungle," and also in a novel called "The Man Who Became a Savage," published in 1895 and long out of print. From this expedition he returned to the United States with a zoological museum collection said to have been the richest and most varied ever made in the field by one man up to that time.

His academic work as taxidermist and his collecting experiences in the field qualified him for the next position that opened to him, and in 1882 he was appointed chief taxidermist of the United States National Museum at Washington. While holding this position he was sent by the Government to Montana to collect a group of American bison for the United States National Museum. The specimens then collected were mounted by Dr. Hornaday after returning to Washington, and this bison group marked the beginning of the now popular museum habitat groups. Later the account of this expedition was embodied by Dr. Hornaday in his "Extinction of the American Bison."

In 1888, two years before resigning from his position at the National Museum, Dr. Hornaday had conceived the idea of the establishment of a national zoological park in the nation's capital. Due largely to his efforts, the plan became a reality. He drew the original plans for the proposed park, Congress appropriated \$292,000 to carry out the project, and Dr. Hornaday was made superintendent of the new institution, which was placed under the control of the Smithsonian Institution as one of its departments. Differences of opinion arose, and when changes were made in the original plans, Dr. Hornaday resigned.

During the next six years he engaged in the real estate business in Buffalo, N. Y. During

this period the New York Zoological Society had been organized in 1895 for the purpose of creating a zoological park in New York City. In looking about for a man to head the new institution, the choice of the officers of the Society fell on Dr. Hornaday. He accepted the call, and on April 1, 1896, became the first director of the Zoological Park. Under his skillful supervision and expert knowledge the New York Zoological Park grew into one of the foremost zoological gardens of the world. So closely was Dr. Hornaday's name associated with it that his fame as its director spread throughout the world and he was looked upon as the Dean and Nestor of his profession.

His capacity for work was tremendous. In addition to his arduous duties as Director he early began his efforts in behalf of the protection of wild birds and mammals. Supported by the Zoological Society, he campaigned successfully for such measures as the Bayne Law in the state of New York to prohibit the sale of native game; the insertion into the tariff law of the provision against the importation of wild birds' plumage for millinery purposes; the promotion of the international migratory bird treaty between the United States and Canada; the Snow Creek Game Preserve in Montana, and the establishment of the Montana and Wichita National Bison Ranges.

Convinced that his wild life protection work should be placed upon an enduring basis, he set out to establish the Permanent Wild Life Protection Fund and for this purpose raised by personal solicitation an endowment fund of more than \$100,000. The income from this endowment he was empowered to expend as campaigning trustee in the furtherance of wild life conservation, both at home and abroad. With voice and pen he waged a militant battle in defense of the nation's wild life. He had an uncommon faculty of making enemies, men who were opposed to his ideas and methods, but this opposition only increased the vigor of his campaigns. Fearless and courageous beyond ordinary reckoning, he never minced words but spoke and wrote as his judgment dictated. He had many loyal supporters, both men and women, who were interested in the conservation of wild life and who gave him of their time and money to help promote the causes which he espoused. "Our Vanishing Wild Life," "Wild Life Con-

servation in Theory and Practice," "Thirty Years War for Wild Life," three Biennial Statements of the Permanent Fund, a series of bulletins, newspapers, brochures and magazine articles were only a part of the printed matter he produced in connection with his wild life protection work.

Dr. Hornaday was a most prolific writer. Practically every phase of his career found expression in one or more of his many books. His "Taxidermy and Zoological Collecting" remains a text book to this day, as does the "American Natural History." As a pastime he wrote "Camp Fires in the Canadian Rockies," "Camp Fires on Desert and Lava," "The Minds and Manners of Wild Animals," "A Wild Animal Round-up," "Wild Animal Interviews" and a privately printed book of "Old-Fashioned Verses." During the period of the World War his activities as a publicist caused him to write "Awake! America" and a number of propaganda pamphlets.

In 1880 he founded the National Society of Taxidermists, and in 1907 he was the prime mover in the formation of the American Bison Society, an organization which had for its immediate object the saving of the American bison from the extermination that threatened it, and became its first president.

Not live animals only, either on exhibition in the Zoological Park or living in a wild state, claimed Dr. Hornaday's attention. Dead ones also, in the form of mounted specimens, had an interest for him. As a sportsman and big game hunter he had during the earlier years of his life acquired a number of trophies, to which had been added other specimens until he owned quite a collection. The eventual disposition of this collection caused Dr. Hornaday to consider the problem seriously and of this consideration was born the plan for the establishment of a national collection of heads and horns. He presented his plan to Mr. Madison Grant, also a sportsman and possessor of a number of trophies, and together they laid the foundations for a national collection which eventually grew to such proportions that a building was erected in the Zoological Park especially to house it. Thus the National Heads and Horns Museum, dedicated to the vanishing big game of the world, and the only one of its kind, stands today as a monument to the foresight and labor of

Dr. Hornaday and others in assembling for the benefit of posterity a unique collection of mounted heads and horns of the game animals of the world.

Measured by a double standard of deeds and accomplishments that are lasting monuments to whole-hearted and self-sacrificing labors in behalf of the harassed animal life of the world, and by uprightness of character, Dr. Hornaday was a great man. Many honors came to him in life, but the greatest monument to his memory is the great Zoological Park he helped to build and the unspoken gratitude of defenseless wild creatures for whose better protection and preservation he wrought and fought. His efforts in

their behalf, particularly the migratory waterfowl, continued almost up to the time of his death, when he was in his eighty-third year. Even when bedridden and no longer able to write with his own hand, his active mind composed and dictated Bulletin No. 14 of the Permanent Wild Life Protection Fund, his last published work.

So ended the long and varied career of one who was naturalist, zoologist, taxidermist, explorer, sportsman, administrator, publicist, conservationist and author.

"He rests from his labors, and his works do follow him."

W. REID BLAIR

A Flight Cage for Native Birds

The Exhibition of Common Inhabitants of Our Fields and Swamps and Forests Is a Real Opportunity for Education

W. REID BLAIR

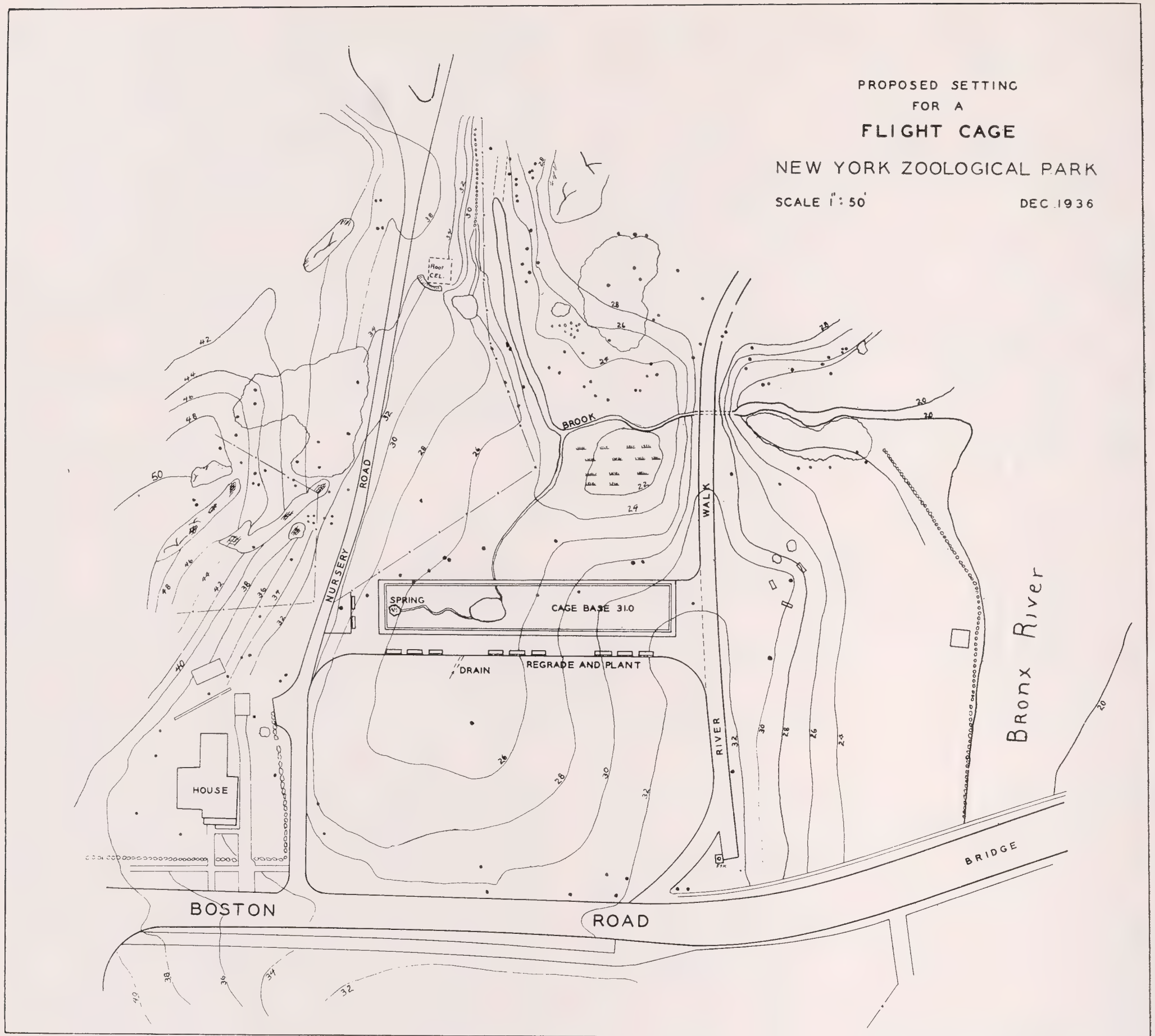
IN the last number of the *Bulletin* I laid before the members of the Society our plans and architects' drawings for a proposed new Bird House for the Zoological Park. In the present article I submit a project somewhat allied with the first piece of proposed construction, and one of really enormous educational value. This is a Flight Cage for birds of the northeastern United States.

It will be recalled by the older members of the Society that the present great Flying Cage for aquatic birds, in the valley between the Bird House and the Aquatic Bird House, was one of the first pieces of permanent construction presented to the Park by the members of the Society. It was erected in 1900, and I daresay that no other single exhibit has given so much pleasure to our visitors; in summertime when pelicans, ibises, herons, spoonbills and gulls are at liberty under that vast dome of wire netting, the shady walks that encircle the cage never lack admiring and interested spectators as long as the Park gates are open. I have had visitors tell me that they sometimes spend whole days beside the aquatic Flying Cage watching the behavior of birds that seem to have no sense of captivity.

What we have done with that outdoor cage for the aquatic birds, we now propose to do for a group of birds in some respects even more interesting. Some members of the Society may feel that at this late date, after so many years of effort by bird protection and study associations, it should not be necessary to make a special point of educating the public in the identification, habits, song and other characteristics of our common native birds. With that feeling I quite agree; it *should* not be necessary, but it most undeniably is.

To the validity of that statement we have had abundant testimony. It has come to be a commonplace to those of us who are in closest contact with the visitors to the Zoological Park that children and adults alike are much more likely to be able to identify correctly some strange and even rare bird from the ends of the earth than some common inhabitant of the fields, marshes or woods of nearby Westchester County, simply because they have so often seen the former in a zoological collection.

The proposed Flight Cage for native birds is the first unit in what we expect to make a most important addition to the exhibition area of the Zoological Park. Since the first grant



of South Bronx Park to the Zoological Society by the City of New York in 1897, the area of something more than 100 acres that lies east of the Boston Post Road has awaited the day when our expanding collections and services to the public made it desirable and necessary to install buildings, ranges, dens and corrals there. That day is long overdue; for several years the opportunities for expansion of the Zoological Park's educational functions have pointed to the utilization of the east side of the Park for exhibition purposes, and we feel that the time has now come when a determined effort should be made by the Society to carry out this program. In the next number of the BULLETIN I expect to present in detail the whole scope of the plan for the development of the Zoological

Park east of the Post Road and along the Bronx River.

The location tentatively selected for the proposed Flight Cage is, from several points of view, ideal for such a structure. North-east of the point where the Bronx River crosses the Post Road, and between the so-called River Walk and the lane leading to the Nursery, there is an area of rolling land, sparsely dotted with trees in its part fronting on the Post Road and descending gradually toward a low, marshy section that has been allowed to grow up in a wilderness of swamp plants and shrubs.

It is on this rolling ground, about two-thirds of the distance from the Post Road to the swamp, that it is proposed to construct the Flight Cage. It so happens that this area has

for many years been a favorite resting place for migratory birds such as thrushes, tanagers, orioles and other native birds, and their preference for the location is the best guarantee we could ask that similar native birds would find the semi-confinement of a huge cage most comfortable.

As will be seen by the sketches accompanying this article, it is proposed to place the axis of the Flight Cage parallel with the Post Road. As we now envision it, the cage will be of truly "out of doors" proportions—200 feet long, 31 feet 4 inches wide, and 28 feet high. In a cage of such dimensions neither the most timid nor the most adventurous birds will have a sense of confinement.

Nothing of the nature of a big Flight Cage for native American birds has ever been attempted by a zoological institution, so far as I know. It offers an opportunity for interesting and valuable pioneering in a field where the educational returns are quickest: among school children. If, as seems likely, we could exhibit in the Flight Cage a really large and representative series of native birds, under such condi-

tions that their nesting and food habits could be studied with ease, I know of few types of exhibits that could as successfully supplement and further the nature study work of the New York City schools.

To facilitate observation of the inhabitants of the cage, we plan to surround it on the two ends and on the front side by wide, bench-lined walks. At the back, where the land drops away to the marshy area, a thick tangle of trees and shrubs will be planted, not only to provide a natural background for the cage but to shut off access to the cage from that side and to give the birds a sense of shelter and protection.

Inside a cage of such dimensions there is plenty of room, of course, for small trees, shrubs and vines, so that every type of habitat necessary to the birds we keep will be provided.

A most interesting feature of the plan calls for the creation of a semi-artificial pool to occupy a large area near the center of the cage. However little the average visitor knows about the native birds of forest and field, even less seems to be known about the birds that love the neighborhood of water—the stilts, godwits, curlews,



oyster-catchers, turnstones, sandpipers, plovers, the smaller rails, and so on. It will be possible to create inside the Flight Cage conditions that will be ideal for birds of that type—muddy banks, both flowing and still water, and cover of sedge and marsh grass.

In the beginning, at least, it is planned to exhibit only the hardier native birds that can well pass the winter in the open cage. It is safe to say that many species of our song and insectivorous birds could easily survive the cold of our winters if they could obtain a constant supply of food. It is not the cold that drives them south, but the annual failure of their food supply.

One of the most remarkable of the mental traits of wild creatures is the quickness with which they become aware of the fact that they are protected, and that within certain bound-

daries their lives are secure. Given this security, and plentiful food, our guests in the Flight Cage will be well content to spend the whole year with us.

Among the species it is proposed to exhibit are robins, hermit thrushes, the rose-breasted grosbeak, purple finches, fox sparrows, song sparrows, white-throated sparrows, tree sparrows, juncos, chickadees, nuthatches, cowbirds, flickers, the bob-white quail, bluebirds, bluejays—but the latter, of course, only if specimens can be found that will “behave themselves” and not molest other birds that share the enclosure with them.

All these birds are perfectly able to withstand a New York winter, and the opportunity to study them the year 'round will, we believe, be an invaluable contribution to the education of the public.

The World's Most Dangerous Snakes

Cobras and Their Tree-dwelling Relatives, the Mambas, Have Earned that Reputation by Their Powerful Poisons

RAYMOND L. DITMARS

AS this article relates to what the author has come to consider the world's most dangerous snakes, a description of their origin and ancestry is of interest at the beginning.

The cobras had their origin in Africa, where a dozen typical species with dilatable necks or “hoods” are widely distributed. From this headquarters the clan extended eastward into Asia and far beyond the geological breakup that formed the island chain of Malaysia. The extended eastward extension of the cobra genus, however, resulted in but two species becoming established outside of Africa. One is the common “Indian” cobra to be found from Transcaspiia through India and Ceylon to China, thence through the Malay Archipelago and throughout the Philippines. The other is the much larger king cobra, with lesser Asiatic range, occurring from eastern India to southern China, thence through Malaysia to and including the Philippines.

Thus it will be seen how the cobra genus, *Naja*, is heavily concentrated in Africa. Its

members have close relationship to the typical harmless snakes; in fact, look like them except when rearing in combat attitude and expanding the neck by means of long, laterally moveable ribs. The fang development of cobras and all their allies is crude as compared to the highly specialized poison-conducting teeth of the viperine serpents. There is a pair of very short and fixed poison fangs, while the vipers have long, canaliculated fangs on moveable bones enabling these teeth to fold back against the roof of the mouth when not in use. The cobras and allies are hence but slightly modified from the general development of harmless snakes. In fact, some reptile specialists think it proper to consider them but members of a subfamily from the grouping of typically harmless snakes.

Despite the rather crude fang development appearing among these types, they have acquired very powerful poisons. The venom of all the elapids—the cobras and related types—attacks nerve centers, particularly those which activate the muscles of respiration, and victims



The black mamba is ever on the move, gliding swiftly and easily over the branches in its cage-tree and rearing constantly to inspect its surroundings. Note its fine, smooth scales and the length and shape of its slender—but deadly—head.

from their bites die principally from a rapidly developing paralysis of the muscles controlling the areas of the chest and diaphragm. The toxicity of poisons among various species of the elapids differs to a considerable extent, as do symptoms that are evident after a bite. With some of the elapids, the complex poison appears to contain elements which attack the heart muscles.

The cobras are largely terrestrial. Most of them are rather clumsy in climbing, but with the existence of such a clan as ancestral stock it is natural that there should originate within it tendencies of pioneering toward various habits. One such offshoot is apparent in the aquatic cobra inhabiting Lake Tanganyika and the rivers to the westward. Another is the extremely active and slender Gold's cobra which lives in

quite open places and can glide with astonishing speed. In acquiring more slender outlines it has largely lost the dilatable power of neck. Such are immediately related species among the larger elapids. Of more remote origin from such stock are forms which have taken to the trees, and such are the mambas, which are tree cobras, with excessively slender body and of great activity.

A number of viperine snakes have become arboreal and have developed particularly virulent poisons, as they feed largely on birds and their venoms must quickly subdue such elusive prey. A tree crotalid of the fer-de-lance genus, inhabiting an island off eastern Brazil, has a venom of far higher toxicity than others of South America's abundant grouping of highly dangerous serpents. Hence it is not surprising

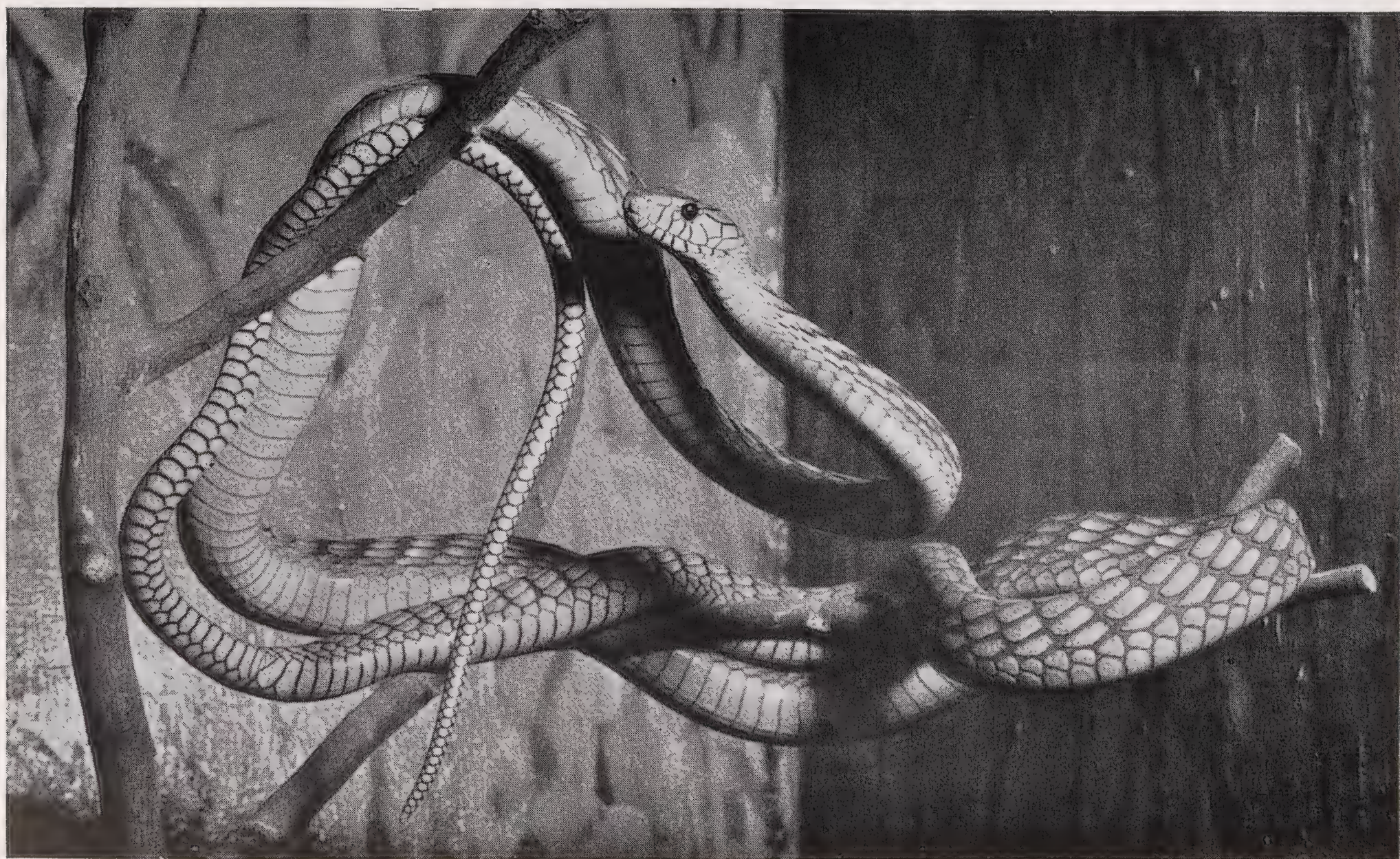
to note that the mambas, unique among the larger elapids in being arboreal, have likewise acquired lethal secretion of poison glands which appears to give them rank as the most deadly snakes of Africa.

There are four species of mambas, their genus being technically defined as *Dendraspis*. One ranges well into tropical Africa and westward, another appears to be restricted to the western tropical portion. Two others inhabit the southern third of the continent. The latter two are so similar in form that it is only by a matter of a few scales, scientifically considered, that they show any difference. The more tropical species look quite different from the South African kinds. Their actions are different and their reputation less sinister. All are extremely slender and whip-like, with narrow head which is not distinct from the neck. In outline they are the personification of a harmless snake. Anteriorly, on the upper jaw, however, and almost under the snout, is a pair of poison fangs which are relatively long for an elapid. These fangs are very fine in structure. In the head of a

preserved mamba they are so delicate that with slight pressure they may be bent like the terminal of a wisp-broom straw. Their infolding grooves, forming a canal to a poison vent at their tips, can thus be surmised as extremely small, yet a single droplet from either of these venom-injecting teeth—a quarter of an inch long in a big mamba—may be enough to cause death with a human.

All of the mambas are commonly of a greenish coloration, bright or ranging into olivaceous hues. *Dendraspis viridis* of the west coast is particularly striking, usually leaf green. Its scales are relatively very large for a snake, making it appear as if it were clad in overlapping green feathers. Its eyes are large and alert.

The writer has observed a number of specimens of this species. They are extremely active and nervous. We have found that they will not survive as captives if more than one specimen is kept in a cage. Thus, in isolation, a large green mamba has been living a number of years in our Reptile House, longer, we believe, than any other records among captive mambas.



The green mamba is distinctively marked and externally bears little resemblance to the black mamba. It, too, is a most active snake and has the ability to lift almost half its length straight up in the air and to hold a rigid position.

This specimen has provided the Reptile House staff with several thrills. Once we attempted to transfer it to a temporary case when repairs to the building were going on. But in seeking to guide it from its cage a mere touch with a bamboo staff produced a flash of green body outside the door and we saw the serpent bite and chew on the edge of the prospective receptacle; then the mamba was gone. We gazed about in bewilderment, only to find that the snake had returned to its cage, ascended a tree and was looking down at us with open mouth. Caution changed our tactics to constructing a box-trap, which was placed in the cage and baited with a dead mouse. By this means the mamba was captured and safely transferred.

After early studies of the psychology of these snakes I attempted to record some motion picture records of the West African mamba. The studio was specifically designed for the portrayal of different types of animal life and many poisonous reptiles have been filmed there, but that mamba, though successfully photographed, is the last of its genus that will ever pose before my camera. The evening terminated in the whip-like body flashing among overhead pulleys and electric conduits in a demonstration that still lingers in my mind. These experiences related to the large-scaled mambas of the upper, tropical portions of Africa, but the more southern species holds the palm for activity and irritability. Its mental alertness places it on a level with the king cobra, which has long been considered to be unique among snakes in its indicated keen intelligence.

The species referred to is scientifically known as *Dendraspis angusticeps*. It occurs in both green and black phases, the latter variety as frequent as the green and growing to considerable length. Its scales are of average size for a serpent of its length, and, in fact, the very dark specimens—and the species ranges into shades of brown—are not unlike the common American blacksnake, somewhat more slender and with narrower head. In the sunlight a curious "bloom," as with all mambas in good health, is to be seen along the scales, much like the surface of an unbruised grape. In some lights it appears like a dusting with whitish powder. The head and neck, however, are as polished as if coated with lacquer. This variety of mamba, inhabiting the greater portion of Africa

south of the Congo, grows to be at least ten feet long, but a specimen of that length would not be more than two inches in diameter at the thickest part.

The black mamba is the most dreaded snake of Africa. There are many dramatic stories of its wanton attack and speedy death from its bites. Even the professional snake collectors hesitate to make attempts to capture it. One such man told me that the actions of a black mamba were so quick and erratic that they might be compared to a long steel spring coiled into many loops and suddenly released. He said that he might attempt to snare a black mamba in some open place, but if it got into the bush he would not think of following it. There was no telling what the creature might do in its lightning-like threading through branches. It might charge straight for an entangled man and bite him in the face.

With numerous details such as this in mind, the writer was much interested to note the cage habits of the first black mamba to arrive in our Reptile House for exhibition. This specimen, about six feet long, continues to thrive, as indicated by the characteristic bloom on its satiny scales.

When this snake arrived at the Park it was in a netted box and on examining it we were surprised to see it on its back, glaring at us with mouth wide open. The inside of its mouth was as black as if steeped in ink. I soon discovered that the position of the snake did not come from its having been injured. It had thrown itself into that posture, most curious for a snake, when we removed the burlap that shielded the mesh covering of its traveling box.

The box was placed in a very large and high cage containing a cedar tree. A slide in the box was loosened and the cage door rolled nearly shut. A long rod was used to push out the slide of the box. A moment later the mamba was at the top of the tree, glaring down with its black mouth wide open. The snake remained at the top of the tree the rest of the day.

It was after dark that the writer with a flashlight went out to inspect the new arrival. The mamba was traveling around its cage in a continuous glide. Its power to extend at least half of its body vertically or horizontally without support was surprising. On the gravel floor it crossed and recrossed with its anterior portion

held in a high, oblique plane. It inspected all corners of the cage, peering at dark spots or, alternatively, at movements of the writer's flashlight, turning toward the glass cage front with open mouth. There was no movement to rush forward and attack, nor was there any sign of fear. The impression was of a snake of astonishing energy, graceful speed and alertness, conducting a systematic search of its quarters. In the morning we made an adjustment of the ventilator flaps in the ceiling of the cage, which opening is covered with strong mesh. The reptile watched us intently and for an hour afterward kept changing its position and intently regarded the ventilator from different angles. Later in the day we saw a part of its body extended upward as straight as a cane as it closely peered around the frame of the ventilator, examining the structure with its forked tongue. It is of interest to check such actions against the stories of wild mambas. F. W. Fitzsimons, who has written more about the snakes of South Africa than any other scientist, in one of his later books¹ has the following to say about the South African mamba:

"To see the mamba skimming over the top of low bushes and matted drooping grass and through the foliage of trees suggests the flight of an arrow. *Makopa* this dreaded reptile is often termed, and the natives of the north term it *Muriti-wa-lesu*, 'the shadow of death' . . . There is the instance of a farmer who attempted to catch one of these reptiles alive, and got fatally bitten in the act. The snake had entered a room, and, leaving the door open to enable him to retreat if necessary, the young man advanced on the snake with a butterfly net on a long pole. But the reptile was too agile and it made a dash for the doorway, and incidentally bit the man in passing. It appears that the Director of a Continental Zoo was anxious to secure a couple of green mambas, and the agent in Durban had offered a high price which tempted the young fellow to make the attempt to capture the specimens, but he lost his life in the venture . . .

"A young farmer in Swaziland was at a buck hunt and the natives had started beating the sides of a wooded slope, beginning at the top

and spreading out in a semi-circle. The young man was riding at a walking pace along a Kaffir path toward the beaters, seeking for a suitable stance to obtain a good shot at any buck which might break cover. Down from the rocky and wooded hills came a large black mamba which had been scared from its lair by the cries of the natives and the barking of the dogs. The man had no time to shoot before the snake was upon him. All he saw was a blackish confusion of coils before he felt the smart of the bite on his upraised arm, which was bare to the elbow. He soon became paralyzed and died within two hours."

Such descriptions are among many of similar nature in the writings of Fitzsimons and others. It appears that the mambas are particularly inclined to attack during the breeding season, which occurs once a year, during the late spring. Then, again, there are mambas which are particularly irritable as individuals, and may deliberately attack a human at any time. There is no doubt that a mamba which is cornered is highly dangerous at any time of the year. There are prospectors commonly going into the bush who declare they have never met a mamba showing a disposition to attack, the attitude being to glide quickly away from the presence of the human intruder. Such men, however, have keen respect for the reputation of mambas, and have not hindered the retreats of the reptiles—unless to shoot them.

Mamba bites are described as killing strong humans in less than two hours, indicating a much higher toxicity of venom than that of cobras. Again, victims have seemingly recovered from the initial shock, but were overwhelmed with fatal paralytic symptoms as much as twenty-four hours later. With all of these bad marks standing against the species of the genus *Dendraspis*, and particularly the black mamba of that group, it is natural that mambas should also figure in books of fiction, and here the tales about them go into details far more sinister than the reptiles deserve. It all explains the wide interest in reptiles of this kind, even among visitors to an American zoological park. If there was no mamba in our collection, we would feel that there was a gap among the types of exhibits that are of greatest interest to the visiting public.

¹ Snakes. Hutchinson & Co., Ltd. London, 1932.

Neptune's Knight: the Seahorse

With Its Prehensile Tail and Its Curious Form, It Occupies a Distinctive Place Among all the Denizens of the Sea

JAMES W. ATZ

Here is a fish the head of which resembles that of a horse; with a hard-jointed external skeleton resembling that of an insect; with a prehensile tail like a monkey's; and with a pouch on its underside for carrying its young after the fashion of a kangaroo, but the male instead of the female acts as an incubator and carries the young.¹

AND, we might add to the above — eyes that can be moved independently, like those of a chameleon! Such is the seahorse, surely an unimaginable beast that could only be found in the realms of fact. Man has invented the griffin and the jabberwock, but it is significant that the creatures of fact greatly outnumber the creations of his superstition and fancy. What man, given only the basic vertebrate structural plan to work from, could conceive of the platypus, the aard-vark, or even the commonplace elephant? The seahorse surely belongs among the best efforts of Nature's, instead of Man's, imagination.

All Man can do is to classify it. He has placed it in the Order Lophobranchii, whose members are characterized by an external (as well as an internal) skeleton, a lengthening of the skull into a tubular snout, and a peculiar gill structure. Instead of forming consecutive plates as in most fishes, the gills of the lophobranchs are fashioned into numerous small, rounded tufts.

The term "seahorse" is loosely applied to three or four genera, but for clarity's sake we will use it to indicate solely the genus *Hippocampus*. There are about fifty species of this genus alone. The scientific name is derived from two Greek words: *hippos*, meaning horse, and *kampe*, meaning worm or caterpillar. Its aptness is self-evident.

As would be expected, these unusual animals have evoked comment from philosophers and scholars for many years. The Greeks of the First Century A.D., however, were more interested in the medicinal properties of the fish than in its life history. Its ashes, when mixed with oil or pitch and applied externally, were considered a cure for baldness, canker and leprosy. Internal administration was believed by some to be a remedy for the bite of a mad dog, but other ancient writers thought the stuff poisonous. The medieval writers took their cue

from the ancients and were content to discuss the pharmaceutical properties of the seahorse, but they apparently confused the actual creature with the original "hippocampus," a mythical sea-monster of the classical Greek poets. From such confusions the "Equus marinus" of von Cube undoubtedly arose. In early zoological atlases (published around 1500) the seahorse was called "Zidrach," sea-dragon, but in later volumes descriptions of the animal can be found under two different headings, "Zidrach" and "Equus Marinus." To make matters worse, still later authors confused these



A literal conception of the seahorse: "Equus Marinus," pictured in the 1536 edition of von Cube's "Ortus Sanitatis." (Reproduced from the Smithsonian Report, 1915).

two with the shark-sucker (*Remora*)! Conrad Gesner (1558), the great encyclopedist, distinguished the *Remora* from the seahorse, but

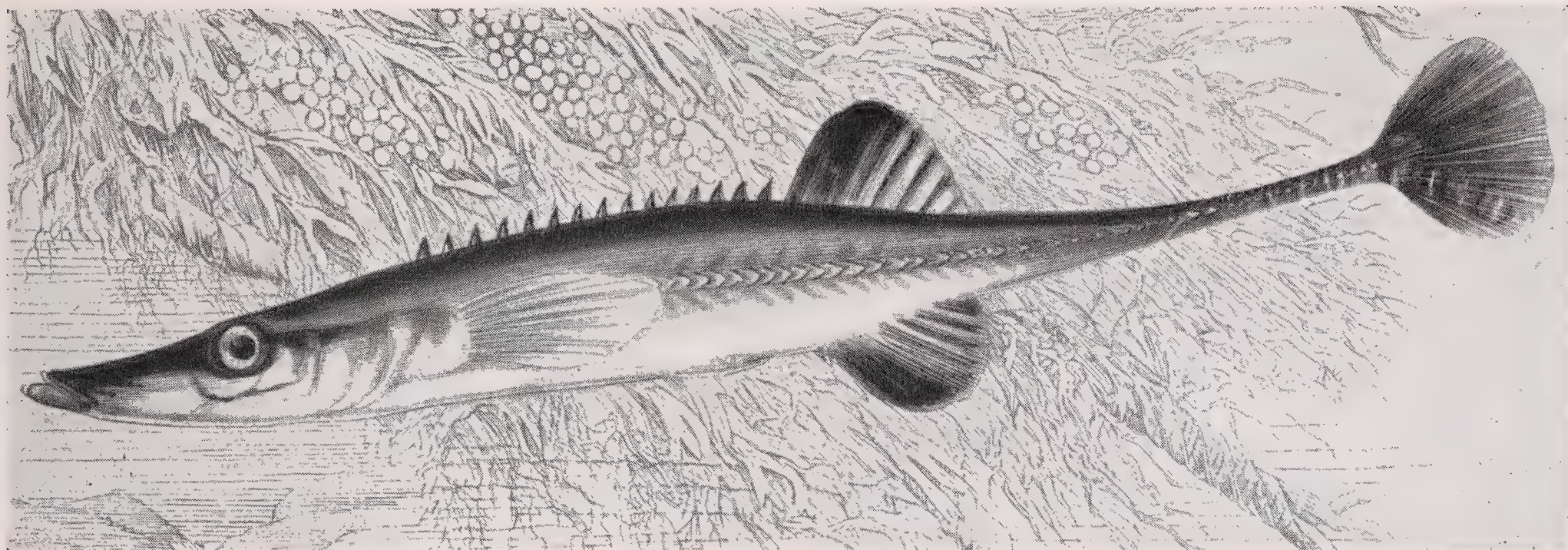
¹ Ginsburg, Isaac (1937). Review of the seahorses (*Hippocampus*) found on the coasts of the American continents and of Europe. *Proc. U. S. Nat. Mus.*, Vol. 83, No. 2997.



Copyright, Nature Films.



(Upper). This underwater photograph from the floor of Great South Bay shows seahorses in their favorite feeding ground, among sea-lettuce and eel-grass. (Lower) The "hitching post" in an exhibition tank, where the seahorses rest and sleep.



The 15-spined stickleback is a rather primitive form, and its long snout is a clue to its relationship to the seashore.

(From "Fishes of the British Islands," 1877).

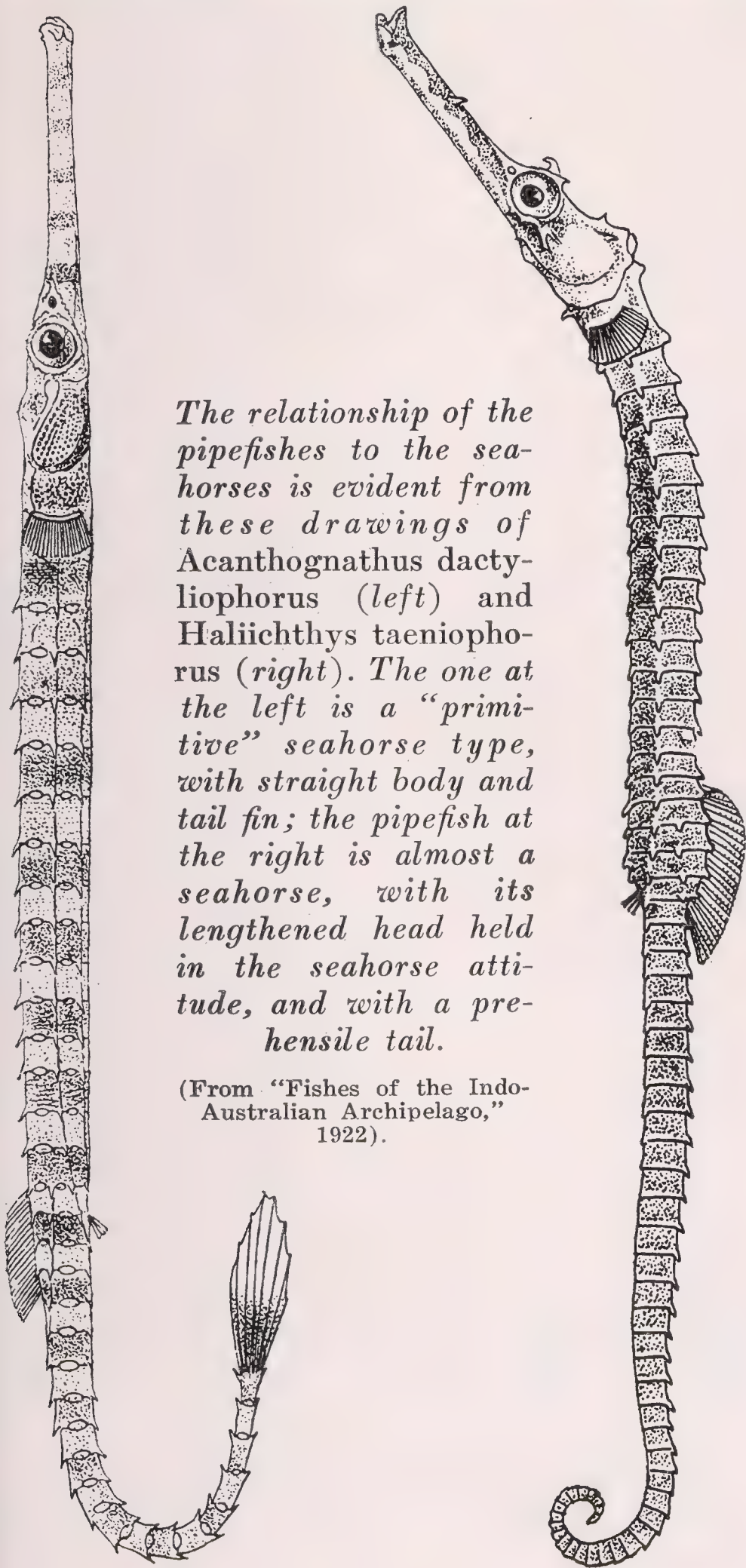
described the latter under *three* separate titles, apparently never realizing that he was writing about one beast. It was from such chaos that modern zoology originated.

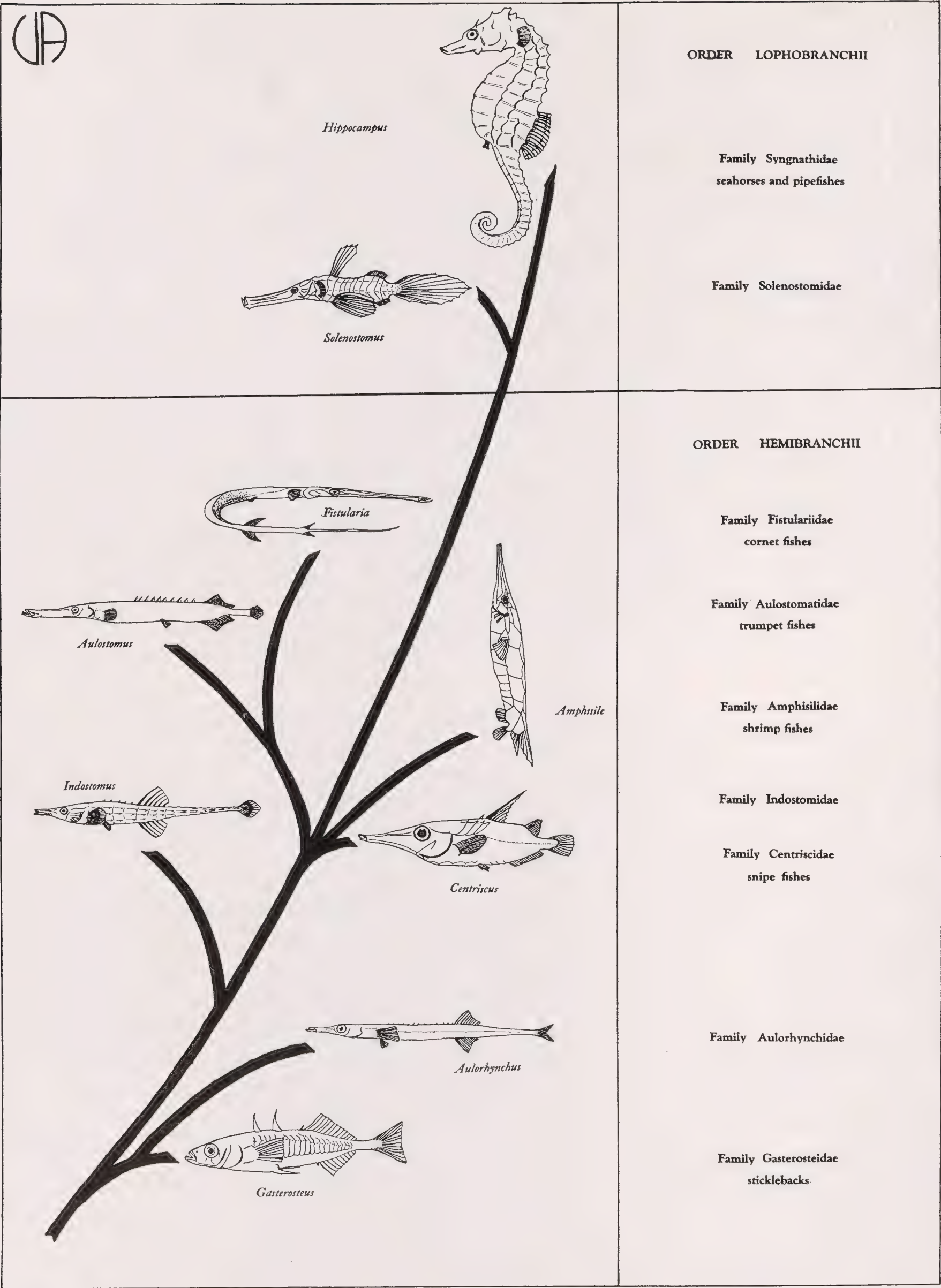
Even today, as in olden times, *Hippocampus* is employed medically in certain European countries. However, the only other utility seahorses seem to have is their world-wide use as souvenirs, charms, and so forth. Because of their firm exoskeletons, drying does not noticeably distort them, and they keep indefinitely. Their striking similarity to the knight of the chess board has led some devotees of the game to make novelty playing-pieces out of desiccated specimens. Although of very little economic value, they remain one of the most popular denizens of the deep. No other exhibit at the Aquarium is more often inquired about. And the reception of such nature films as "Trailing the Seahorse" in theatres throughout the country demonstrates that even those who never visit Battery Park are not apathetic to the creature's engaging ways.

How did these peculiarly specialized fishes evolve? It seems most probable that they arose from the Gasterosteidae, or sticklebacks. From a species with an elongated snout like *Spinachia vulgaris*, a form similar to the members of the present-day Centriscidae (Macrorhamphosidae) could have been derived by still further lengthening the snout and enlarging one of the dorsal spines. From this family a type like *Solenostomus cyanopterus* could have developed. This fish is undoubtedly not unlike the ancestor

The relationship of the pipefishes to the seahorses is evident from these drawings of Acanthognathus dactyliophorus (left) and Haliichthys taeniophorus (right). The one at the left is a "primitive" seahorse type, with straight body and tail fin; the pipefish at the right is almost a seahorse, with its lengthened head held in the seahorse attitude, and with a prehensile tail.

(From "Fishes of the Indo-Australian Archipelago," 1922).





A family tree, illustrated by present-day fishes, showing the living relatives of the seahorse. Many intermediate fishes, of course, lie between the seahorse of today and its progenitor of millions of years ago. The line started with an extinct fish that somewhat resembled the sticklebacks, and through various evolutionary changes as shown here the seahorse evolved. Amphisile, incidentally, swims upright like a seahorse.

(Chart based upon Gregory and Bolin).



From Camb. Nat. Hist., 1904.

The "sea dragon," *Phyllopteryx eques*, resembles the seaweed that is its usual habitat in Australian waters.

of the family Syngnathidae to which the seahorses and pipefishes belong. The latter presents a wide range of types, passing from the typical pipefishes, which are straight and more or less tubular in shape and which possesses well-developed caudal fins, through others which have a thickened trunk and prehensile tail with no fin, to the typical seahorses (*Hippocampus*) on the one hand and the bizarre sea-dragons (*Phyllopteryx*) on the other. The evolutionary relationships among the twenty or more genera, however, have yet to be completely worked out.

According to the latest taxonomic consideration of the group,² there are four species of *Hippocampus* on the Atlantic coast of North America, and one of these (*H. obtusus*) is extremely rare, only the type specimen being known. The common seahorse (*H. hudsonius*) occurs from Cape Cod and rarely Nova Scotia to the Rio Grande on the Gulf coast. Two geographic races exist, one (*H. hudsonius punctulatus*) being confined to Florida in the United

States and extending into the West Indies, the other (*H. h. hudsonius*) including all the remaining area. These boundaries are arbitrary, however, for the two populations grade into one another. Florida waters are also the habitat of the dwarf seahorse (*H. zosterae*), and a related species (*H. regulus*) is found on the shores of Mississippi, Texas and Mexico. The type (*H. h. hudsonius*), which is common in some areas within fifty miles of New York City, has been reported from the East River, but that was many years ago.



This baby seahorse, born at the Aquarium in 1934, was three days old when its microphotograph was taken.

² Ginsberg, Isaac. *Ibidem*.

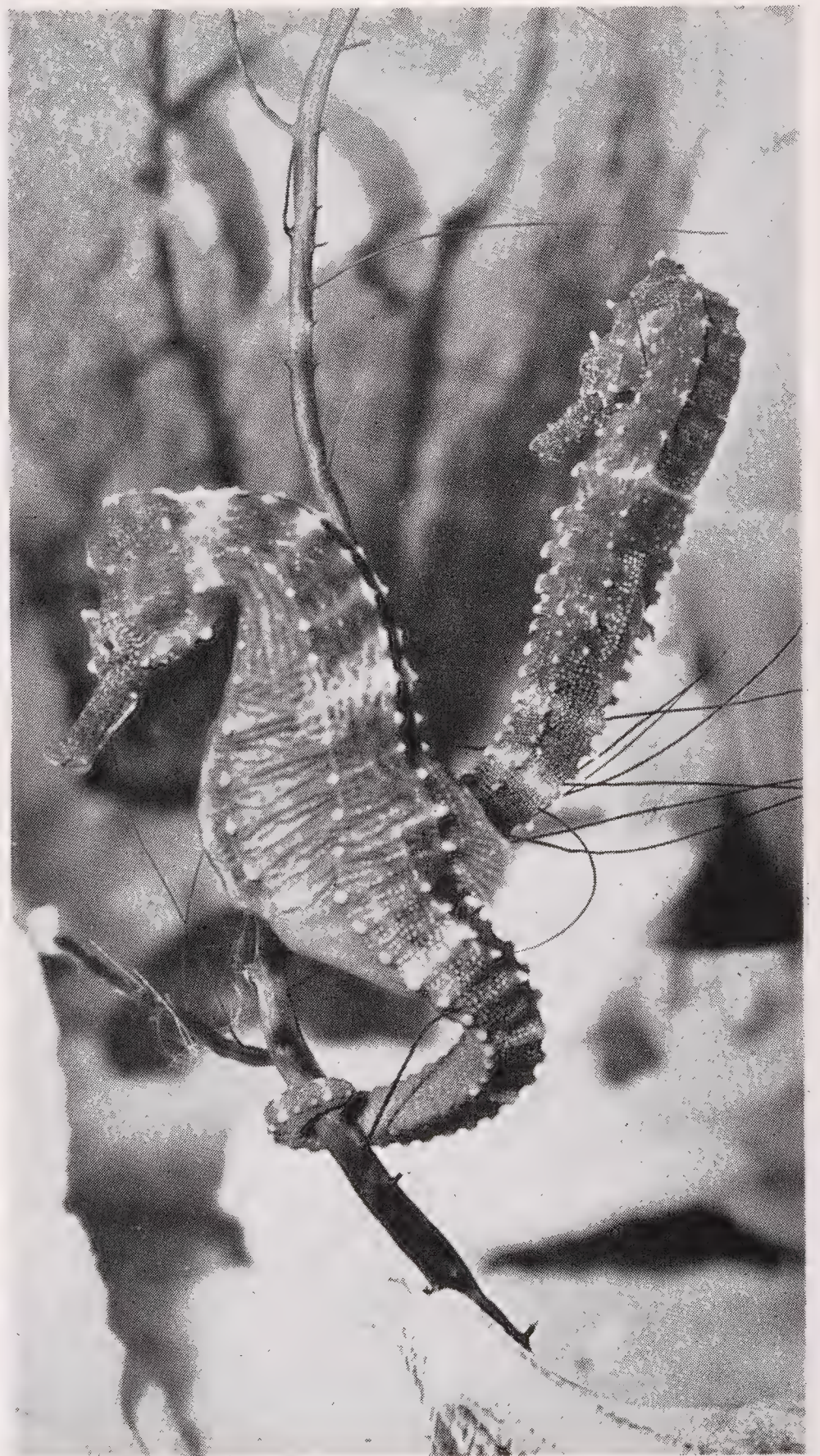


Two ways of swimming: upright for slow travel, horizontal for speed. Horizontally the dorsal fin is undulated.

Probably the most prevalent misconception about seahorses is that they grow to considerable size. Time after time visitors have come to the Aquarium and, after gazing with casual interest at the tank of seahorses, have asked attendants where "the big seahorses" are exhibited. They have, it turns out, mistaken the full-sized adults for "babies," or "colts," and sometimes they make it very plain that they do not believe the attendants when they explain that no seahorse grows to be four or five feet long.

As a matter of fact, the usual length of an adult *Hippocampus hudsonius* is only about four inches. However, the record specimen exceeds this by three and one-half inches. The dwarf seahorse never extends over two inches, and the largest member of the genus (*H. ingens*), which is found on the west coast of the Americas, barely reaches one foot.

The seahorses are typically found near the oceans' shores, and those recorded from mid-water may with few exceptions be considered accidental. Here they live amid eel-grass (*Zostera marina*) and other littoral marine plants. They are usually regarded as protectively colored, and do possess power to change their hue. Those which inhabit tropical shores and reefs, emblazoned with hydroids, sponges and the like, are said to take on brilliant green, red, and silver spots and blotches. And once in a while those zoophytes are found actually growing on the armor of the little marine knight. But quite



The southern seahorse has a longer snout, more spots and less well developed tubercles than the northern. The fish in the foreground is a male, as may be seen by the brood pouch.

often appendages and filaments³ are grown by the fish itself. These seem to occur indiscriminately throughout *Hippocampus*; males and females, young and old, are found both with and without. In certain species a higher percentage of individuals grow filaments, and the young of all seem more likely to be so adorned. Therefore, these appendages cannot be used as a diagnostic character in *Hippocampus*. In another genus (*Phyllopteryx*) this decoration reaches its acme. Either the seahorse is well-protected by these contrivances or he is a distasteful morsel, for he has been but rarely found in another fish's stomach.

The relatively inflexible exoskeleton and the peculiar shape of the seahorse precludes an ordinary mode of locomotion. The caudal and ventral fins have been lost, and the anal has been so reduced as to be of little significance in movement. Most of the time the long axis of the body is held vertical. The dorsal fin has become the principal locomotor organ. To go up or down it is undulated, to go forward, that is, belly foremost, it is vibrated rapidly from side to side. The pectorals also aid in forward movement. When more rapid progress is desired the fish takes an almost horizontal position and undulates its dorsal. Much of a seahorse's life, however, is spent attached to the plants in its habitat by means of its prehensile tail. This grasping structure is unknown in fishes outside the Lophobranchii, and not many members of this family outside of *Hippocampus* possess it.

The grasping action of the tail is apparently governed by a simple reflex. A finger placed on the concave side of the caudal end of one is all that is needed to induce the appendage to take hold of the digit firmly. In baby seahorses this reflex is also strong—and not too well directed in some instances. Now and then an infant will try to anchor himself to such insubstantials as bubbles or straws. M. W. Young (1926) reports how he lost a brood of 160-200 *Hippocampus abdominalis* in fourteen days, probably because of this reflex.

It appeared to me that their habit of congregating in clumps of from four to thirty individuals had something to do with the high casualty rate. The method of forming these clumps was as follows: Two sea-horses would swim together and, either from accident or design, interlock their

tails Then another would swim up and hitch his tail between the first two. This building-up process would continue until there was a writhing, struggling mass from which each individual seemed powerless to extricate itself even under the stimulus of fear.⁴

The long snout of the seahorse is admirably adapted for a certain type of feeding. The fish seeks its food usually in the recesses of the vegetation in which it lives, using the snout as a probing instrument, and when a "bug" is discovered it is sucked in and goes down the gullet whole, as seahorses have no teeth.

They enjoy a variety of foods, but all of them minute forms of animal life—copepods, *Gammarus* (a common amphipod), mysid shrimps, the larvae of various higher forms of crustaceans, and possibly the eggs and fry of other fishes. The crustaceans that, according to most observers, make up the bulk of the seahorses' food are often called "the insects of the sea," and like the insects of the land and air they are extremely abundant and come in all sizes, so that seahorses at home seldom lack plenty of food.

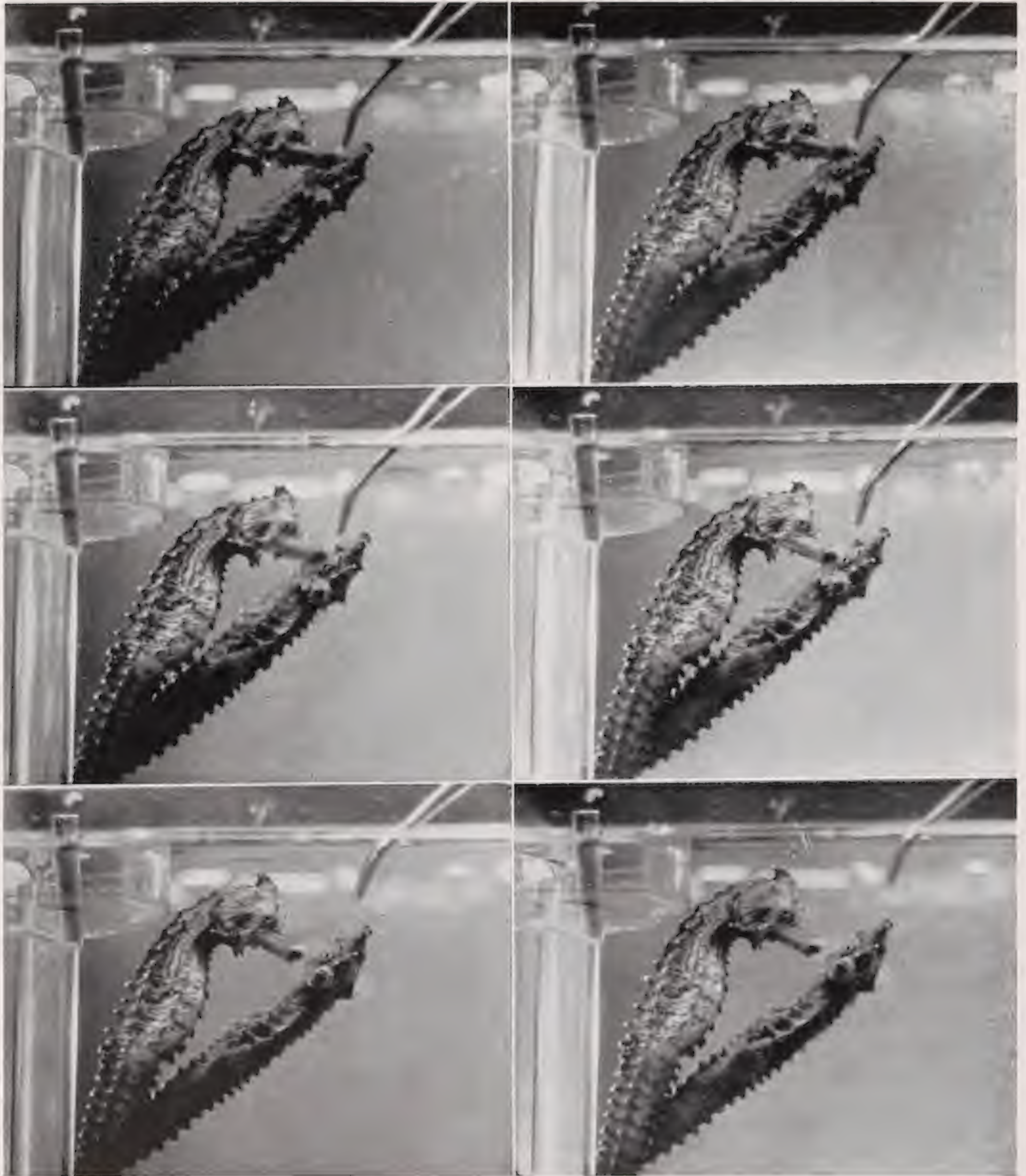
It is usually said that no seahorse in captivity will ever take non-living matter. Certainly it has been the experience of the Aquarium that it is difficult enough to get them to take even living matter—*Gammarus*—of which they are quite fond. A good half of a day can be occupied in picking up tiny, quarter-inch *Gammarus* with tweezers and dropping them in the water directly in front of the seahorses' snouts. If the *Gammarus* is attractively presented, perhaps the seahorse will "snap" at it and engulf it; more likely, the piece of food will swim away unmolested, and the attendant has to try again. Actually, every seahorse in the tank has to be fed by hand, and treated as an individual problem.

If a large number of *Gammarus* are dumped in the seahorses' tank on the theory that the fishes will do their own foraging, the *Gammarus* are likely to turn predator and attack the seahorses, burrowing through their armor and killing them.

No fish has more singular breeding habits than the members of the Lophobranchii. In both the pipefishes and seahorses it is the male who incubates the eggs—either in an open or closed groove in the former, or a pouch in the latter,

³ It has been assumed by practically all investigators that the only use these appendages might have is to hide the animal from its enemies by making it appear like the vegetation in which it makes its home.

⁴ *New Zealand Jour. Sci. and Tech.*, Vol. 8, No. 5, page 284.



Copyright, Nature Films.

The white spot at the end of the tweezers in the upper left picture is a bit of Gammarus. These motion pictures (left to right), were taken at intervals of 1/24th of a second; it required a quarter of a second for the seahorse to snap and swallow.

and in the Solenostomidae the female carries her eggs in a pocket formed by her belly-wall and ventral fins. The pouch or marsupium of *Hip-*

pocampus is located ventrally under the forward portion of the animal's tail with a slit-like opening at the upper end. A few females have rudi-

mentary pouches, but to the old naturalists *all* individuals with them were female. They did not know that in fish exhibiting parental care it is the rule, rather than the exception, that the father protects the eggs and rears the offspring. Not until 1831, when Eckstroem reported on a European pipefish, was the sex of the egg-carrier correctly given. And the disputes which followed lasted some forty years.

Little or nothing is known about the habits of the seahorses elsewhere than in the Atlantic ocean and the Mediterranean Sea. The observations reported here were made on species from those waters. In preparation for the eggs the walls of the male's pouch are said to thicken and become well-vascularized. After a rather elaborate courtship the female deposits the eggs directly in the incubator chamber, at which time they are fertilized. Once inside, each fertile egg becomes embedded in the lining of the pouch, actually becoming more or less buried in paternal tissue. For this reason it is believed that the developing young receive some sort of nourishment from their father. That an exchange of oxygen and carbon dioxide takes place between father and embryo is undoubtedly true, for the pouch is sealed, and no sea-water enters or leaves it during development. Seahorse eggs evidently require this special care, because all attempts to culture them have failed.

After about forty-five days the young, rather well-developed, are ejected. This appears to be an exhausting task. The male struggles violently, pressing his full pouch against rocks, shells, and so forth in his efforts to dislodge his offspring. There are only 150 to 200 in a brood, but they shoot out of the little opening

in small bunches, and the whole process may last several days. This difficulty may be traced to the embedding of the young in the tissues of the pouch. After all the babies have been "born," the male may flush out his brood-sac by turning it wrong side out with the aid of some solid object, as when evicting the young.

In temperate climates mating apparently takes place in the spring and summer. Incubating males of *Hippocampus h. hudsonius* have been taken from Great South Bay, Long Island, from June through early September. The young of this species average about a quarter of an inch in length. Males in aquaria often die after the exertions of liberating a brood, but such captive fishes are most likely already in a somewhat weakened condition. Death after reproduction probably does not hold for most seahorses in nature, although for certain pipefishes it seems to be the rule.

The record longevity in captivity is four years and seven months, according to Major S. S. Flower, the authority on vertebrate life-spans. This was made by a specimen of *Hippocampus h. hudsonius*, one of a shipment from the New York Aquarium to the aquarium in Venice, California.⁵

Because they require circulating sea-water and live food, seahorses do not thrive in home aquaria. This is most unfortunate, for if they did so they would certainly be the most popular of aquatic pets.⁶

⁵ Townsend, C. H. (1920). *Bull. N. Y. Zool. Soc.*, Vol. XXIII, No. 6, page 118.

⁶ The author wishes to express his appreciation to C. M. Breder Jr., who made invaluable suggestions and gave much needed aid, and to Dr. R. F. Nigrelli and S. C. Dunton for photographs. Dr. W. K. Gregory kindly reviewed the phylogenetic chart and pointed out the Indostomidae to the author.



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NOTES FROM THE ZOOLOGICAL PARK AND THE AQUARIUM

Dr. Charles R. Schroeder

Dr. Charles Robbins Schroeder, formerly Veterinarian and Pathologist for the Zoological Society of San Diego, California, has joined the staff of the New York Zoological Park as Veterinarian to succeed Dr. Charles V. Noback, whose death occurred on January 16.

Dr. Schroeder was born in New York City, attended Ethical Culture School and Stuyvesant High School here, and received the degrees of D.V.M. and B.S. from Washington State College. He was for three years Immunologist at the Lederle Laboratories at Pearl River, New York, and for the past five years has had charge of the health of the animal collection of the San Diego Zoo.

By training and experience Dr. Schroeder is admirably equipped to carry on the exacting duties of Veterinarian in the New York Zoological Park, both on the side of practical veterinary work and that of scientific research. He assumed his new duties here on March 1.

From Cats to Clover

What connection exists between the common house cat and a fine stand of red clover? Dr. Hamilton mentions "Darwin's classic example" of the connection, in his article on "The Value of Predatory Mammals," and it is thus interesting to exhume the example from the "Origin of Species." It follows:

"I am tempted to give one more instance showing how plants and animals remote in the scale of nature, are bound together by a web of complex relations. I shall hereafter have occasion to show that the exotic *Lobelia fulgens* is never

visited in my garden by insects, and consequently, from its peculiar structure, never sets a seed. Nearly all our orchidaceous plants absolutely require the visits of insects to remove their pollen-masses and thus to fertilise them. I find from experiments that humble-bees are almost indispensable to the fertilisation of the heartsease (*Viola tricolor*), for other bees do not visit this flower. I have also found that the visits of bees are necessary for the fertilisation of some kinds of clover; for instance, 20 heads of Dutch clover (*Trifolium repens*) yielded 2,290 seeds, but 20 other heads protected from bees produced not one. Again, 100 heads of red clover (*T. pratense*) produced 2,700 seeds, but the same number of protected heads produced not a single seed. Humble-bees alone visit red clover, as other bees cannot reach the nectar. It has been suggested that moths may fertilise the clovers; but I doubt whether they could do so in the case of the red clover, from their weight not being sufficient to depress the wing petals. Hence we may infer as highly probable that, if the whole genus of humble-bees became extinct or very rare in England, the heartsease and red clover would become very rare, or wholly disappear. The number of humble-bees in any district depends in a great measure upon the number of field-mice, which destroy their combs and nests; and Col. Newman, who has long attended to the habits of humble-bees, believes that 'more than two-thirds of them are thus destroyed all over England.' Now the number of mice is largely dependent, as every one knows, on the number of cats; and Col. Newman says, 'Near villages and small towns I have found the nests of humble-bees more numerous than elsewhere, which I attribute to the number of cats that destroy the mice.' Hence it is quite credible that the presence of a feline animal in large numbers in a district might determine, through the intervention first of mice and then of bees, the frequency of certain flowers in that district!"

On Keeping Anableps

A small shipment of young Four-eyed Fish, *Anableps anableps*, was received at the Aquarium on February 18, from Mr. Albert Pinkus who collected them along the Demerara River, British Guiana. They did not survive the night following arrival, however, which seems to be in keeping with the general behavior of these fishes after importation.

The difficulties inherent in keeping them in aquaria, although well-recognized, are still unsolved. However, last year we were able to keep four *A. anableps* for nine months, a decided improvement on the previous record of two or three days after arrival in New York, and one specimen of *Anableps dowei*, received from Yucatan in March last year, is still alive and on exhibition in the Aquarium.

Since all but one of our original shipments were males which fought continually if kept together and moped and refused food if isolated, we thought there might be a possibility of the fish spawning in the Aquarium, for several attempts at mating were observed, but although the males were mature the solitary female turned out to be immature and we were unable to start the hoped-for aquarium stock.

There are so many peculiarities to be investi-

gated in these fishes that we consider it highly desirable to establish an aquarium strain and have requested our friends and collectors who fish the waters of northern South America and Mexico to bring to us as many as they reasonably can.—C. W. C.

Sanctuaries for Antelope

Two new Federal sanctuaries of the pronghorn antelope have been established in the heart of its native range in southeastern Oregon and northwestern Nevada. One is a 276,000-acre refuge and the other a 539,000-acre winter and early spring range. In announcing their creation the Bureau of Biological Survey said:

"The refuge, to be known as the Hart Mountain Antelope Refuge, is in Lake County, Oregon. This area is a part of the range for big-game animals established in 1935 in connection with the organization of western grazing districts under the Taylor Grazing Act of 1934.

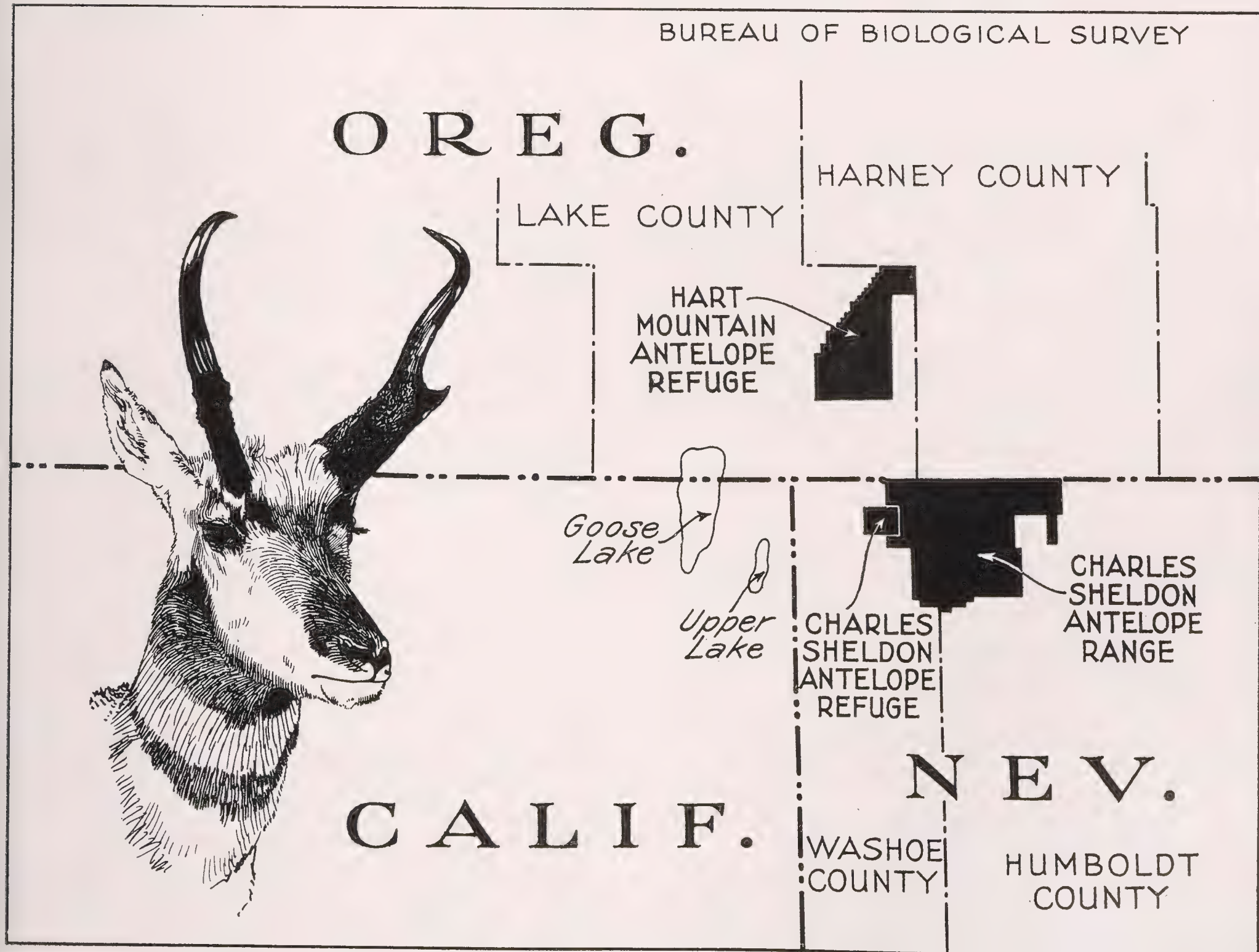
"The new range is in Humboldt and Washoe Counties in Nevada, about twenty miles southeast of the Hart Mountain area. It adjoins and supplements the 34,280-acre Charles Sheldon Antelope refuge established in Nevada six years ago, and has been similarly named the Charles Sheldon Antelope Range.

"Some of the Hart Mountain antelope and practically all the animals that summer on the old Charles Sheldon refuge move in the winter

for feed to the lower altitudes in the nearby Nevada area now established as a Federal antelope range. In the spring these animals drift back to the two refuges. Sagebrush areas in these two refuges are favorite fawning grounds for the antelope, or pronghorns. The does 'cache' their newly-born fawns, often twins and occasionally triplets, among the rocks and low sage. They wander far from their young for feed and water, but return twice daily to feed them.

"Although the new refuge and range have been established primarily for antelope, both areas are also suitable for native deer, sage grouse, fur animals, waterfowl, and other wildlife with which they are well stocked. The Biological Survey will administer the Hart Mountain refuge, and under the executive order the Secretaries of Agriculture and the Interior are to be in charge of the conservation and development of wildlife on the new Charles Sheldon range. The Secretary of the Interior will also regulate livestock grazing on the public domain of the range.

"Before unrestricted hunting and the advance of civilization reduced the numbers of antelope to small scattered bands, these animals were widely distributed in the sagebrush plains in the region where Nevada, Oregon, Idaho, and California meet, and in other semi-arid regions of the West. Predators and disease also made deep inroads into their ranks. Since then protection by State laws and the control of coyotes and other



predators, particularly on the fawning grounds, have made the pronghorn a familiar sight again in many Western regions. It is conservatively estimated that there are at least 10,000 pronghorns in the Nevada, Oregon, and California areas as compared to the dwindling thousand that existed there sixteen years ago. Wyoming today has probably the largest number of antelope in any State. In Wyoming these animals range in scattered groups over much of the plains and desert region. Authorities have recently estimated that there are 15,000 antelope in this State.

"The new refuge and range not only provide additional protection for antelope but they also insure a more adequate feed supply. The chief problem connected with the conservation of pronghorns is that of providing areas where they can feed. For several years these animals have faced serious feed shortage as a result of continued subnormal rainfall and overgrazing of their range by livestock. The badly over-grazed range on the Charles Sheldon refuge has, however, made remarkable recovery under protection and slightly improved moisture conditions. Purchase by the Biological Survey of privately owned lands within the Oregon refuge and Nevada range for supplying antelope with forage and water, and to enable the development of the areas for waterfowl and other wildlife, is well under way.

"The number of antelope has materially increased since the Charles Sheldon refuge was established for the protection of their fawning grounds and summer range. Through the National Association of Audubon Societies and the Boone and Crockett Club, funds were provided for the purchase of private lands in the refuge, and Public Works Projects have provided for the fence, administration buildings, water development and conservation, patrol roads, and firebreaks. The C.C.C. has also helped to improve the refuge. The barbed-wire fence that encloses the refuge excludes livestock but permits antelope and deer to enter and leave. Antelope simply 'duck' under the lower strand of wire often at full speed without touching it.

"In 1921 it was estimated that the number of antelope on the summer range in the Hart Mountain area had dwindled to 200. Since then the number has increased to about 4,000—owing largely to coyote-control."

Dovekies Again

Two dovekies (*Alle alle*) were brought into the Aquarium this winter. The first was found in Brooklyn on December 20 by Mr. Herman Fidel. The second was presented on February 1. These rare visitors are presumably blown in from the Atlantic where they spend the winter. The last record of them in the vicinity of New York City was, so far as we know, in November, 1932. Curator Crandall reported on this invasion in the BULLETIN, Volume XXXV, Number 6.—J. W. A.

"Who's Who in the Zoo"

Publication before May 20 of "Who's Who in the Zoo," a 250-page natural history of mammals, has been announced by the W. P. A. Federal Writers' Project of New York City. The book

will contain a considerable number of photographs supplied by the Zoological Park.

The preliminary announcement of the book states that it "will tell the life story of more than 100 animals in a factual, simply worded, although scientific manner, for persons of all ages."

PUBLICATIONS OF INTEREST

THE REPTILES OF NORTH AMERICA. By Raymond L. Ditmars. 476 pages, 8 color plates, 400 photographs from life. Doubleday, Doran & Co., Garden City, New York, 1936.

The first edition of this book by the Curator of Mammals and Reptiles at the New York Zoological Park appeared twenty-nine years ago under the title of *The Reptile Book*, as one of the volumes in The Nature Library. Immediately it assumed the position of the standard work on the reptiles of North America, and laymen and scientists alike found it so valuable for reference for study and identification of reptiles that it has been reprinted in many editions.

Two years ago the author undertook a complete rewriting that would bring all parts of it up to date. Rewritten, virtually a new book, it now appears in a new title and a handsome binding.

In recent years there have been many changes in nomenclature of the reptiles of the United States and Canada. Since the first edition of Dr. Ditmars' work, 28 new species of snakes, 47 lizards and 10 turtles have been added to the scientific lists. The new book describes 333 species of North American reptiles. Of these 2 are crocodilians, 140 are lizards, 136 are snakes and 55 are turtles and tortoises. Many new subspecies are also included. New keys for identification of the species of various genera have been prepared. As an example of the extent of these keys, the key to the main rattlesnake genus, *Crotalus*, covers the greater part of four pages. Other revisions include the extension of distribution and notes on the habits of reptiles. The sections devoted to the snakes have been much expanded.

In the résumé introducing the serpent sections, the author says:

"Advances in knowledge coming from studies of snakes in recent years cover feeding habits, distribution, the relative toxicity of poisons of the venomous species and the treatment of snake bite. Studies of reptilian relationship have brought great advancement and materially altered the scientific lists. Hitherto 'full species' have been dropped from that rating, though most of them have retained standing under varietal or subspecific names. Then again, subspecies which for many years remained as such have been accorded recognition as distinct species."

The handling of the 135 plates renders their examination very easy. The plates are in uninterrupted continuity at the back of the volume, with detailed captions under each cut. Preceding these particularly fine illustrations is a detailed list of the plates with cross reference to page numbers in the text. The book also contains a complete and annotated bibliography.

With the revision of the present work, Dr. Ditmars now has three important and widely circulated volumes to his credit. *Reptiles of the World* and *Snakes of the World*, both imposing volumes, are international standards.

Back numbers of ZOOLOGICA wanted—

Members of the Zoological Society or others who have back numbers of *Zoologica*, listed below, for which they have no further use will confer a favor on the Department of Publication if they will return them to the publication office. The numbers desired are now virtually or actually out of print and it frequently happens that scientific institutions and libraries forming complete sets of *Zoologica* are disappointed in not being able to obtain the missing numbers.

In order to be in a position to supply our technical journal to scientists who can make use of it, the Department of Publication would be grateful for the return of the numbers of *Zoologica* listed below.

Volume, I, Number 8. The Northern Elephant Seal *Macrorhinus angustirostris*. Townsend.

Volume IV, Number 5. The Locomotion of Fishes. Breder.

Volume VII, Number 1. The Three-toed Sloth. Beebe.

Volume XII, Number 10. Clearing and Dyeing Fish for Bone Study. Hollister.

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PUBLICATIONS

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Bulletin: The official publication of the New York Zoological Society reports bi-monthly on interesting phases of work at the Park and the Aquarium and contains articles on natural history in a sound yet popular form, with many illustrations. Thirty-eight volumes have been completed.

Zoologica: Scientific contributions of the New York Zoological Society. Volumes I-XIX and Volume XXI are complete, and Volume XX is in preparation. Volume XXII will be issued during 1937, in quarterly parts. *Zoologica* is sent to Members on request.

[*Zoopathologica*, Scientific contributions of the New York Zoological Society on the diseases of animals, has been discontinued and future papers on animal pathology will appear in *Zoologica*. *Zoopathologica* is complete in Volumes I and II, which are indexed.]

Annual Report: Documents, reports and pictures of the work of the various departments of the Park and the Aquarium. As a rule it contains articles of scientific value and considerable general interest.

Gallery of Wild Animal Paintings in the Zoological Park: A handsomely illustrated catalogue of the gallery in the Administration Building at the Park, which Members may receive on request.

A classified list of the publications of the Society, with subject headings of articles printed in the *Report*, *Zoologica* and *Zoopathologica*, as well as reprints from them, will be furnished on request. Some of the publications have become exhausted and orders for any issues will be governed by this circumstance. Orders for any of the publications should be addressed to H. R. MITCHELL, *Manager, Zoological Park*, 185th street and Southern Boulevard, New York City.

No effort will be spared to ensure delivery of the regular publications to Members of the Society, but changes of address, forwarding points and non-delivery of mail should be reported promptly. Back numbers of *Bulletin* still in print will be supplied to Members and others at the rate of 30 cents each. Postage and handling, 5 cents extra.

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NEW YORK ZOOLOGICAL SOCIETY



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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

Annual Membership in the Society is \$10, renewable annually. Life Membership may be obtained for \$200. A contributor of \$1,000 becomes a Patron; \$2,500 an Associate Founder; \$5,000 a Founder; \$10,000 a Founder in Perpetuity, and \$25,000 a Benefactor.

All classes of Members are entitled to receive every periodical publication, the privileges of the Administration Building with its lounges and reception rooms and gallery of paintings of animals, to attend lectures, open meetings and entertainments, and to be admitted free to the Zoological Park and the Aquarium every day in the year.

Application for Membership may be given to the Director of the Zoological

Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 101 Park Avenue, New York City, for action by the Executive Committee.

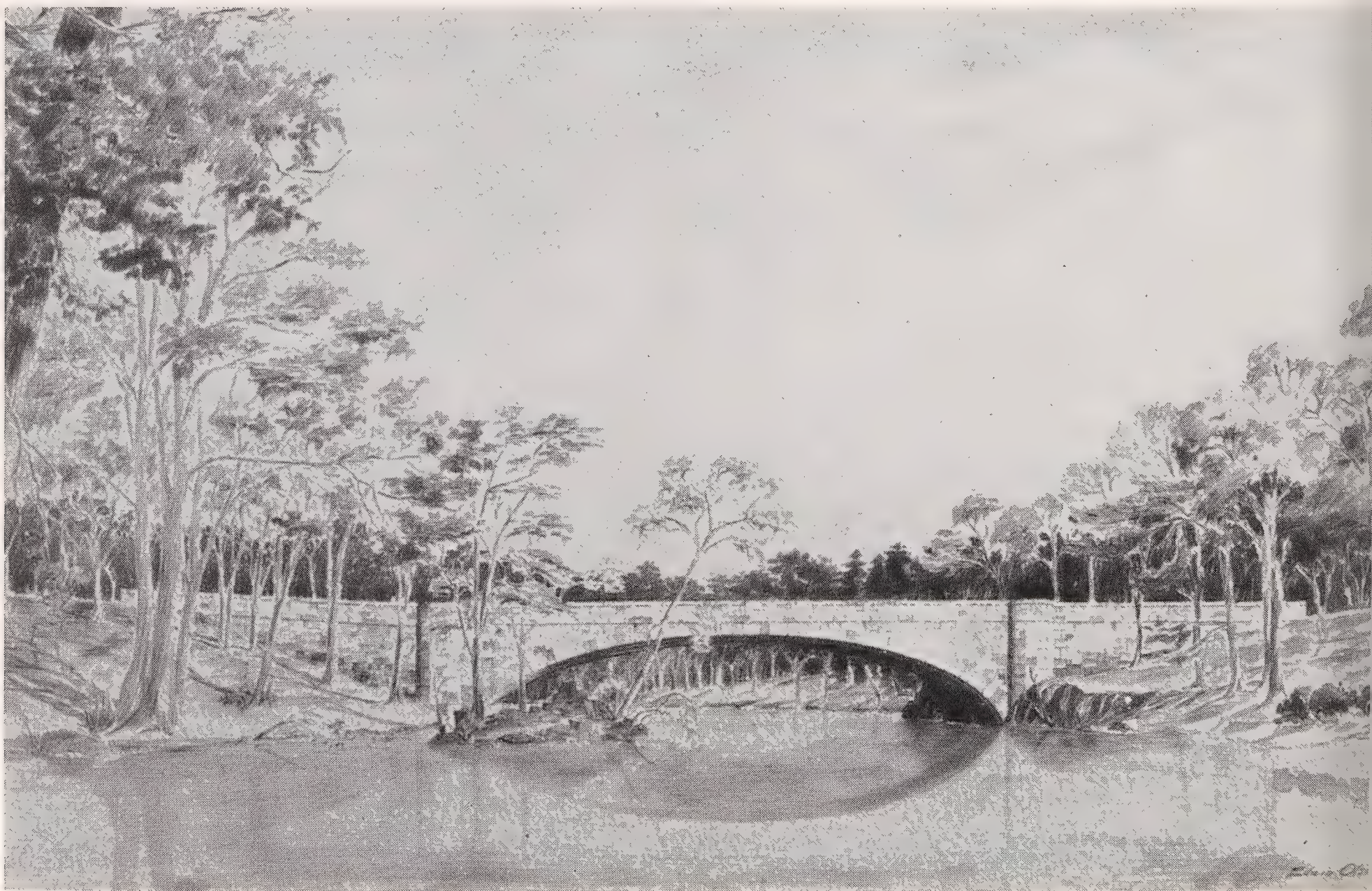
The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



The sites of the new Monkey Island, or barless enclosure, and the bridge that will give easy access to it from the Boston Post Road and the part of the Zoological Park lying to the west, are shown on this map. The barless enclosure is the oval area just to the left of the center; the bridge location is near the right margin of the map. A pleasant walk along the Bronx River will connect the bridge and the Monkey Island.

The architect's drawing, accurately reflecting the natural setting of the proposed bridge site, presents a handsome perspective of the 135-foot single arch of stone. The engineering plans for the bridge have already been worked out in detail, and the roads and connecting walks surveyed. From the west side, access to the bridge will be from the Boston Post Road just opposite the Buffalo entrance to the Zoological Park.



BULLETIN

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A Monkey Island and a New Bridge

By a Rotation of Exhibits the Barless Enclosure in Bronx Park
East Would Be Used the Year 'Round

W. REID BLAIR

OUTDOOR exhibits of large numbers of the primates, in barless enclosures, are a comparatively recent development in zoological park planning, but there is not one installation ancient or modern that exceeds them in permanent popular interest. Large series of related zoological forms, such as we have always tried to exhibit, may be of far more scientific and educational value, or certain rare and unusual animals may give rise to greater curiosity when first exhibited, but it has been the experience of several zoological parks that over a period of years "monkey islands" are of supreme entertainment value.

Entertainment, so long as it is not stressed to the detriment of more important considerations, is one of the legitimate functions of a zoological park, and the thousands of persons who pass through our Primate House on holidays are ample testimony to the popularity of even such exhibits, in restricted numbers, as we are able to make at present. Indeed, the week-end crowds that are drawn to the Primate House as by a magnet are so great as to present a real problem. Recently an European anthropologist of distinction, who had tried in vain to get into the building on a Sunday to inspect our collection of anthropoid apes, was compelled to ask my assistance in finding a way to get through the crowds and into the building. It was only by leading him through the keepers' entrance and into the service alley behind the cages that he was able to see the collection. I, like the

visitor, found it absolutely impossible to enter the building by the main doors without a long wait in line.

An outdoor installation, or Monkey Island, is a practical method of exhibiting large colonies of monkeys under such conditions that they can be seen distinctly and comfortably by thousands of visitors at a time. It has been the practice of many of the zoological institutions that have installed such features to create comparatively small, and usually artificial, islands surrounded by concrete moats either dry and steep, or broad and water-filled. In the northern part of the United States where winter weather makes it impossible to exhibit the monkeys the year 'round, the enclosure is of necessity abandoned for five to seven months of the year.

Fortunately less inhibited by considerations of conserving space, we have drawn up a project for the New York Zoological Park that will be of sufficient size to accommodate a very large number of animals, and will by a rotation of exhibits be available throughout the entire twelve months.

The installation as projected will occupy an elevated portion of the Zoological Park lying east of the Boston Post Road and east of the Bronx River. Approximately it will lie directly across the river from the Boathouse Restaurant.

The site selected is a large, gradually sloping, well-wooded hill which on its southern side breaks abruptly on a ledge of rock. The engineering work necessary to convert it into an



The crown of this gently sloping hill, roughly the area marked out by the trees, is the site tentatively chosen for the new Monkey Island. The encircling moat would be cut through the foreground of the picture. The view is looking southward.

isolated area is not excessive nor costly. The engineer's plan, presented herewith, indicates an enclosing concrete moat ten feet deep and twenty feet wide. Immediately outside the moat a public walk will encircle the whole island.

The area thus encircled is approximately 300 feet long and 150 feet wide, in a flattened oval form. It contains on its northern side a gentle grassy slope, approaching a portion wooded with tall trees, and a sufficient outcropping of rock to make it possible to construct numerous natural caves or shelters.

Since the primary purpose of the enclosure is to colonize it with monkeys, most of the undergrowth and low shrubbery that would obstruct sight of them must be cleared away and a small section of a projecting rock ledge must be removed. Despite the size of the area, which is several times larger than most zoological parks have set aside for such installations, we believe that the inhabitants will at all times be close enough for easy inspection, and the space is certainly large enough to give the animals a complete sense of freedom.



A cross-section of the Monkey Island reveals what its form will be when the moat surrounds it. An overhanging ledge of rock must be removed for better visibility.



Looking toward the northwest, the wooded nature of the hill can be seen, as well as the outcropping of rock. Some trees will have to be removed to prevent the more agile inmates from swinging across the moat to the freedom of adjacent trees.

For perhaps seven months of the year, from the time spring unmistakably arrives to the first chill weather of autumn, the Monkey Island will be populated by a colony of rhesus monkeys or, for variety, large numbers of Hamadryas baboons—the latter, especially, being spectacular and interesting animals whose life in the open should be a most attractive feature.

For the colder months, it is planned to replace the exhibits of primates with colonies of coyotes, foxes, wolves or raccoons—the exhibits varying from year to year. The Australian dingo, or wild dog, is another attractive exhibit that might be given its turn on the island, where it would make a much better showing than in its present quarters in the Small Mammal House and the adjacent outdoor runways. Dingos have bred freely in the Zoological Park and might

be expected to increase considerably in the wild freedom of the island.

The variety of exhibits, indeed, that might be placed on such an enclosure is large, and it is our plan to rotate them constantly so as to make use of the area throughout the entire year.

To give access to that part of the Zoological Park lying east of the Bronx River, it will be necessary to construct a bridge, and engineering plans for that structure have already been drawn up. An attractive stone bridge, of a single arch 135 feet wide, has been plotted to cross the river directly opposite the present Buffalo Entrance to the Park lands on the west side of the Boston Post Road.

From the bridgehead connecting walks will carry visitors along the river to the broad walk encircling the Monkey Island.

Feeding the Animals

Twenty-five Hundred "Boarders" Require a Variety of Foods at Intervals of Five Minutes to Two Weeks

WILLIAM BRIDGES

THE job of feeding some 2,500 wild animals with tastes that range all the way from fresh blood to sunflower seeds is a function that never ceases to interest visitors to the Zoological Park. It seems a task of infinite complexity, and yet the feeding arrangements are essentially simple. The first principle is to give every animal what it would eat in the wild, of its own accord, if that is possible; the second is to find acceptable substitutes if the natural food is not available.

Finding substitutes is not as difficult as it might appear. It is manifestly impossible to provide an elephant, say, with the actual kind of grass that it would eat if turned loose in Africa or India, but no elephant will complain about good-quality timothy or clover hay. The food habits of the giant anteater are just what his name implies, but specimens have lived for years on chopped meat, hen eggs and milk. Substitutes that at first glance appear highly unlikely to please the taste of a particular animal sometimes are entirely satisfactory in actual practice.

The Zoological Park must set its table for boarders who dine at intervals ranging from five minutes to two weeks, and the intervals, as well as the diet, are important. A hungry man may figuratively bark at his waiter if the fish course lags a few minutes behind the soup, but sea-lions literally bark at their keeper if their fish are not in sight by 3 o'clock every afternoon. Indeed, they usually start barking about 2:30 o'clock and keep it up until every butterfish has disappeared! The feeding interval is of even more importance to small birds. Hummingbirds, for example, must have food in their small cages at all times. Out of a shipment of six hummers that were sent up to the Zoological Park from the Battery by taxicab, with no provision for

feeding on the way, five were actually comatose from hunger exhaustion and one was dead when they arrived.

An established routine of feeding is one of the basic laws of the business of keeping animals healthy. The cook is usually the first man in the Zoological Park in the morning. He arrives at 6:30 o'clock and until the middle of the afternoon he scarcely looks up from his butcher's block and his pressure cooker. A few minutes after 7 A. M. the keeper of the bears is in the cookhouse filling his baskets with bread and meats and vegetables, and at intervals through the day a truck carries away supplies for the various exhibition houses, or unloads the raw foods to be prepared for the following day. Quarters of bull beef or horsemeat must be cut, ground or cooked; eggs apportioned in the proper quantities for each house according to a schedule which lists the daily changes in diet; fruits and vegetables and bread distributed in the same way, frozen fish thawed and sliced, rice cooked.

Between trips to the cookhouse the commissary truck delivers grain and hay supplies from the barn and granery, fresh vegetables from the Nursery, and such odds and ends of mice, rats, chickens, squabs, guinea pigs and other small animals that may be required from the breeding cages. At intervals the trucks of commercial food purveyors roll into the Park to deliver a variety of foods. All day long there is a constant coming and going of food supplies, for the animals must be fed regularly, properly and on time.

Based on the experience of previous years, the animals will eat during 1937 approximately the following: 170 baskets of apples, 1,350 bunches of bananas, 40 boxes of huckleberries,



All of the cooking and much of the cutting, grinding and other work of preparing food for the animals is done in the Cookhouse. (Below). The Nursery, where great quantities of vegetables are grown, is an important unit of the feeding routine.



The sight of his keeper in the distance, with the familiar pail of butterfish on his arm, sent this sealion into a high dive and a race for the opposite side of the pool where the keeper always stands to distribute dinner.

51½ tons of beef, 20½ tons of bread (mostly rye), 135 bushels of carrots, 1,300 chamelons, 500 pounds of cottage cheese, 260 pounds of chicken, 30 tons of corn, 220 pounds of ant eggs, 31,200 hen eggs, 22½ tons of scratch feed, 15¼ tons of fish, 1,600 frogs, 150 pounds of grapes, 290 tons of hay, 18 cans of honey, 6,300 pounds of zwieback meal, 1,200 pounds of milk powder, 75 pounds of Brazil nuts, 100 pounds of mixed nuts, 7,000 bushels of oats, 80 boxes of oranges, 600 pounds of oyster shells, 160 pounds of raisins, 200 white rats, 1,300 pounds of brown rice, 800 pounds of broken rice, 500 pounds of rock salt, a ton of hemp seed, 1¼ tons of sunflower seeds, 300 pounds of dried shrimp, 9,000 pounds of wheat, 50 pounds of dried flies—and almost a hundred other foods in mostly lesser quantities.

Altogether the variety of foods that are more or less standard on the menu of the Zoological Park will run close to 150 kinds, although some of them are bought in very small quantities and

only when a particular animal shows a need for them or when they come on the market at favorable prices. Other foods such as elderberries and wild strawberries that tickle the fancy of certain of the birds are not available on the market, but keepers often spend their own time foraging for delicacies they know their charges will like.

Of all the animal groups—mammals, birds, reptiles—the birds demand the widest variety of diet. At least ninety different foods are served to the bird collection. Some of them are seasonal and are simply omitted when they cannot be obtained, but in season they are generally to be found in the trays.

Here is the list of bird foods used in the Park, compiled by Curator Crandall and Keeper Stacey:

Apples	Nannyberries
Pears	Tomatoes
Grapes	Carrots
Raisins	Potatoes
Sultanas	Beets
Currants	Peas
Bananas	String Beans

Oranges
Figs
Wild Cherries
Elderberries
Wild Strawberries
Inkberries
Huckleberries
Milo Maize
Oats
Ground Maple Peas
Hemp Seed
Canary Seed
Millet
Rape
Flax Seed
Poppy Seed
Thistle Seed
Teazle Seed
Rock Salt
Watercress
Green Corn
Cottage Cheese
Barley
Codliver Oil
Dandelion Seed
Sunflower Seed
Zwieback
Ant Eggs
Hen Eggs
Crissel
Ground Egg Shells
Cuttlefish Bone
Oyster Shells
Indian Nuts
Bone Meal
Blood Meal
Alfalfa Meal
Quartz Grit

Lettuce
Cabbage
Spinach
Wild Chickweed
Whole Corn
Cracked Corn
Wheat
Dried Milk
Dried Flies
Mealworms
Grasshoppers
Spiders
Cockroaches
Mellin's Food
Condensed Milk
Honey
Fruit Flies
Butterfish
Shrimp
Herrings
Smelts
Beef
Horsemeat
Rats
Mice
Guinea Pigs
Rabbits
Chickens
Frogs
Snakes
Bread
Rice
Game Food
Peanuts
Pecans
Walnuts
Brazil Nuts
Dates

Like all animals on diets that are partly or wholly composed of substitutes for their natural foods, birds have to be tempted by special delicacies now and then. Some of the hummingbirds can be "toned up" by a few fruit flies. The flies are bred on pieces of banana and turned loose in the glass cases that are the hummers' homes. They catch the flies on the wing.

The hummingbirds are the most delicate feeders in the whole animal collection with the possible exception of the pigmy marmoset. Quite a satisfactory substitute for flower nectar has been developed for the hummers by a blending of Mellin's Food, condensed milk and honey. A supply of the liquid is kept in the cages day and night, in small bottles with tiny, red-tipped snouts, and during the daytime the birds feed on the wing at intervals of a few minutes.

In contrast to the few tablespoonfuls of "nectar" that satisfy a hummingbird, the big flightless birds such as the ostriches, emus and cassowaries require generous trays of bread, cab-



No chance of missing one of these mouths! The difficult part of feeding the pelicans—brown, European and American white, shown here—is to make sure that each bird gets a fair share of the fish, but a practiced butterfish-flipper can do it.



Not the food, but a place to serve it, is a problem in feeding the giraffe. He would prefer an even higher table.

bage, lettuce, corn and oats, and in addition they forage on grass in their corrals all through the summer.

Ant eggs, of course, are for the insectivorous birds, and so are the dried waterflies from Mexico. Crickets and grasshoppers are generally of local origin—the meadows in the Zoological Park—although bags of dried grasshoppers from Africa are sometimes purchased. An occasional snake of the small, non-poisonous variety is killed and thrown to the secretary-bird to keep it in good spirits, and common house spiders are excellent tonic for the nightingales when they are “off” a little. Codliver oil because of its high vitamin content is regularly included in the diet of many birds, usually being worked into the zwieback meal mash.

Unlike most of the other animals, whose stomachs are given a rest one or two days a week, when they get no food or only a minimum quantity, all of the birds except the vultures have to be fed every day. Their high rate of metabolism requires it, and while the quantity offered the very large birds can be cut down

from time to time, few of the birds can fast long without danger. Underfeeding is always a possibility, but overfeeding is less likely. With the exception of a few individual birds which “never know when they’ve had enough,” according to their keeper, most birds will disregard a surplus of food left in their cages. The vultures fast one day a week in winter and two days in summer.

Strangely enough, elephants share with birds the trait of being rather particular about their food. Apparently they get tired of looking at it if too much hay is thrown into their stalls at once, and after a while refuse to touch it. For that reason feeding is an all-day job in the Elephant House. Big Alice will consume 75 pounds of hay in a day, mostly timothy hay, but it has to be offered in small bunches. After she has cleaned up one ration another is forked in. Otherwise she would pick out the best and eat all she wanted for the moment, and then walk away and refuse to return to it.

Gunda, the ill-fated elephant who was destroyed some years ago, was a much more voracious



Sometimes a baby has to be handfed until it can be put on an adult diet, as was this puma cub some years ago.



The movements of the photographer were much more interesting to the European red deer than their food, but they soon got over their curiosity. (Below). Pete, the hippopotamus, celebrating a birthday for the newsreels, and enjoying dessert.



Early in the morning the keeper of the bears loads up his cart at the Cookhouse with bread and meat and vegetables and before the Park is open to the public he makes the rounds of the dens. Two loaves of rye bread are going over the top here.

cious eater than Alice, who is nevertheless larger. Gunda's appetite was able to encompass a 200-pound bale of hay overnight.

The 4,500-pound hippopotamus will eat about the same quantity of hay as an elephant almost double his weight. Like other big animals in the Elephant House, the hippo's hay diet is varied by freshly cut grass, green corn stalks, and mangels from the Nursery. A bushel basket of such small food can disappear down the hippo's capacious throat in almost no time and seemingly without affecting his willingness to eat more.

Whereas most animals can be fed on approximately the same diet day in and day out, with only occasional variations, the whole monkey tribe shows a strong inclination for variety. Their liking for a change of food is almost as strong as that of a human. There are four different menus in the Primate House feeding schedule, for four days of the week, three of

them being repeated on the remaining three days.

Monday: Bananas, boiled potatoes, oranges.

Tuesday: Carrots, lettuce, bananas, apples, oranges.

Wednesday: Rice pudding, cabbage.

Thursday: Monday's dinner again.

Friday: Tuesday's dinner.

Saturday: Wednesday's dinner.

Sunday: Nothing but bananas—and the peanuts, popcorn, coughdrops, candy, cigarette butts and chewing gum that thoughtless and sometimes downright vicious visitors throw to the monkeys when the keepers are not at hand.

The practice of visitors, especially the crowds that pack the Primate House on holidays, of throwing food and other objects into the cages is one that endangers the lives of a valuable collection of animals and which the Park has recently taken drastic steps to stamp out. Arrests are being made for throwing improper

foods into the cages, and the offenders fined in Magistrate's Court.

Altruism plays very little part in the lives of the primates and they will rarely divide a bit of food with a cagemate. An exception was the orang-utan, Freda, who would often take food from her own mouth and offer it to Buddy, the chimpanzee. Buddy never reciprocated and offered food to Freda—perhaps because Freda always preempted whatever food was put in the cage and took what she wanted first.

The big cat animals, the lions, tigers, leopards and the like, are confirmed carnivores and slabs of raw meat are their diet six days a week, with one rest day. Ten or twelve pounds of meat and bone keep them in good form.

Armadillos, porcupines, wild dogs, African squirrels and other miscellaneous small mammals might be expected to exhibit radically varying tastes, but their diets are not really complex. Two armadillos will consume in one day a quarter of a pound of raw beef, two or three bananas, and four raw eggs mixed with a quart of milk made from concentrated milk powder. This satisfies them five days a week. One day they are not fed at all, and on Sundays they "piece out" with bananas alone. A South American stripe-tailed dog shows his kinship with domestic dogs by enjoying a quarter of a pound of cooked meat each day, with an occasional raw egg.

More delicate creatures such as the African meerkats, small animals that are said to live largely on insects and grubs and small rodents, have proved able to thrive on a varied diet that includes raw meat on Monday, a sparrow each on Tuesday, a young pigeon on Wednesday, a white mouse and a tiny strip of raw beef on Thursday, one banana each on Friday, raw beef on Saturday, and a few dates or raisins on Sunday. That, of course, is a diet that probably does not differ radically from the food the animal would naturally seek in the wild. Although they are supposed to be insect-eaters, our meerkats refuse mealworms and the large white woods grubs that the keeper has sometimes tried to induce them to take.

Many of the small mammals have developed a taste for the candies that visitors throw them. One of the kinkajous has a passion for peppermint candies and will devour all he can get—which is very few, if the keeper is in sight,

for the animal's digestion might quickly be imperiled. The same kinkajou, when given grapes, invariably tumbles on his back and holds the fruit over his head so that every drop of juice will trickle into his gullet.

Animal intelligence manifests itself in many curious ways. The rattel, or honey badger, would hardly be listed among the ten most intelligent animals, yet he is as ingenious as the grape-eating kinkajou in one way. His eager friendliness and his greediness for food and petting make him a favorite with many visitors and one of them sometimes brings him a lump of loaf sugar, with the keeper's permission. Early in his career the rattel found that loaf sugar was hard to bite, and somehow he hit upon the magical formula of dipping it in his drinking water. It was probably an accident the first time, but the animal remembered—and ever since he has dropped the lump into the drinking pan for a few moments before biting it. He knows, too, just how long to leave it so it will be soft enough to bite and not so soft that it crumbles in his paws.

The kangaroos are among the most leisurely eaters in the animal collection. It is nothing for them to take four hours to clean up their daily ration of carrots, potatoes, sugar beets, cabbage, apples, rye bread and crushed oats. Most of them eat sitting upright with their food held in their small forefeet, but one Woodward kangaroo invariably lies down and encircles his feeding pan with his forelegs so that he can eat without moving any part but his mouth.

The kangaroos are the only members of the Four Hours for Lunch Club in the Kangaroo House. The babirusa bolts his food in a scant ten minutes, and the other inmates are seldom far behind him.

Most of the animals in the Kangaroo House—kangaroos and wallabies, warthog, babirusa, anteater, capybara—enjoy their food all the more by missing one day a week, but the tiny African antelopes known as duikers are so ravenous that if they miss one meal they are likely to gorge and choke on the next. Consequently they are fed half a head of lettuce, two diced apples and one diced carrot and half a pound of crushed oats every day.

When the feeding wagon that Keeper Cully developed for use in the Kangaroo House is rolled down the aisles in front of the cages, with



Feeding time in the Kangaroo House is simplified by the service cart carrying the dinners for each animal. All of the food looks alike, but that is just because it has been covered with a layer of crushed oats to prevent drying out.

white enamel trays neatly stacked on it, visitors have frequently been puzzled by the apparent similarity of the food, since all the trays are smoothly covered with crushed oats. The oats are a part of the menu and are spread over the tops of the trays to keep the fruits and vegetables underneath from drying out if the feeding should happen to be delayed beyond the regular feeding hours of 3 o'clock in winter and 4 o'clock in summer.

The giant anteater, like the duikers, gets seven meals a week. When the present specimen arrived it appeared to be in excellent physical condition but it refused to eat until a handful of ant eggs was borrowed from the Bird House feeding bins and offered it. Once it

started eating, the regular anteater diet was quickly substituted and the animal was satisfied. That diet consists of one pound of raw chopped meat, six raw eggs, one tall can of evaporated milk and an equal amount of hot water, with a small quantity—seldom more than a tablespoonful—of ant eggs as a sort of savory. To human imaginations that diet may seem an extremely artificial substitute for live ants, but the fact remains that anteaters have been known to live as long as ten years on it.

When an aard-vark is on exhibition, its diet is similar to the giant anteater's except that cooked meat is substituted for raw chopped meat.

By force of circumstances the Reptile

House has come to have an extremely varied collection of inmates, by no means all of them ophidians. Its food requirements are, consequently, much broader than they would be if only snakes were housed there, for all snakes are carnivorous.

For the little vampire bats from Trinidad, nocturnal drinkers of blood from human beings, cattle, dogs and horses, the maintenance of a satisfactory diet is extremely simple. Twice a week half a gallon of fresh blood is obtained from one of the New York City slaughterhouses and small glass trays of blood are set in the bottom of the vampires' cage each night. Much of it they waste by messy feeding, but their distended stomachs, and the fact that they have lived more than two years in captivity, indicate that they get plenty to eat.

The larger tropical bats called *Vampyrus spectrum* were long believed to be fruit-eaters but are now definitely known to be entirely carnivorous. Two fair-sized pigeons, cut into small pieces, are sufficient for the nightly meal of three adult "Spectral Vampires" and one almost-grown baby. The baby was born in the Zoological Park and like other mammals nursed during the early part of its life. When it was weaned to a meat diet it still clung to the wire netting top of the cage while its mother fluttered to the floor and seized pieces of meat which she carried back to the roosting place. While mother and baby hung head down side by side, the baby snapped at pieces of pigeon in its mother's jaws until it grew big enough to fly down and take its meat like an adult.

Another mammal somewhat anomalously quartered in the Reptile House is the two-toed sloth. His feeding habits correspond with the rest of his slothful nature, for he may take the greater part of the day to dispose of a small quantity of apple, banana and dampened bread. Apparently the moistened bread and the fruit juices are all the liquid nourishment the animal requires, for in his twelve years in the Reptile House he has never been observed taking a drink of water. Hunger is virtually the only thing that will disturb the equanimity of that slowest of all animals. On Sunday, the day when he is not fed, the sloth actually moves! All day long, one slow leg creeping after another, he shifts restlessly through the limbs of

the tree from which he hangs head downward.

Sharing the warmth and humidity of the Reptile House are a lion marmoset and a pigmy marmoset. Like some other monkeys, they take enthusiastically to insects. Crickets and grasshoppers are such obvious treats to them that their keepers spend many summer hours sweeping the meadows with insect nets. Their staple diet, however, is bananas, apples, and the juices of peaches, pears and strawberries. If crickets and grasshoppers cannot be obtained, as mostly they cannot in winter, a fat cockroach now and then is an acceptable substitute, although the acrid odor of the roaches does not please them. Each night the marmosets are given a freshly killed young lizard. In the case of the four-ounce pigmy, the lizard is not more than two or three inches long. Even if it were not contrary to Zoological Park practice to feed living prey, the lizard would have to be killed for the pigmy. A lizard of even moderate length might give him a real battle before it was subdued.

Snakes rarely come the way of the mongoose, although his kind is famous as a killer of poisonous serpents. No mongoose will go hungry if snakes are not available, however, and in the wild all kinds of small rodents and birds are his alternative prey. Although the Zoological Park's mongoose is given a garter snake or some other small reptile now and then just to keep him in touch with his old life, his ordinary diet is two boiled eggs one morning and a quarter of a pound of beef the following day, with two incubator chicks at intervals of a week or so.

Once a python can be induced to feed, it is usually less trouble than many other animals. A feeding of thirty or forty pounds of freshly killed chickens, feathers and all, is enough to last a big regal python for a full two weeks. Their shedding periods are generally watched and a feeding scheduled at the end of each of the six or seven sheddings a year, with in-between meals when the reptiles seem willing to take food. After each shedding the pythons are usually hungry and betray it by their restlessness.

Once each fifteen days a three- or four-foot gopher snake is killed and dropped in to the king cobra's cage. A momentary moving of the carcass with a stick is enough to give the cobra the illusion that it is alive, and he seizes

his prey. The same tactics is employed to induce other snakes to feed if they insist on live food. Rats, mice, young rabbits, chicks, frogs and miscellaneous small snakes, the latter for the small-sized cannibals, can all be fed to the serpents after being killed.

Nobody knows, perhaps, actually how much the large tortoises will eat, for no tortoise has even shown signs of having had enough. The giants from the Galápagos Islands are fed chiefly on lettuce, apples, oranges and bananas,

and they relish huge slices of watermelon. The biggest specimen, which has grown from the size of a peck measure to 310 pounds in the thirty-some-odd years under observation, willingly consumes a barrel of lettuce leaves in one day. The Galápagos tortoise colony is, indeed, one of the convenient outlets for the surplus lettuce leaves of New York hotels. Outside leaves that are rejected when a head of lettuce is being dressed for salads are saved and the next day make a very fine lunch for the tortoises.



When Buddy, the chimpanzee, was an inmate of the Hospital, he learned to eat with a fork. But now that he is on exhibition he has lost all his manners, and his usual method is to crouch over his food with his mouth resting in it.

The Giant Orioles of the Tropics

Guarded by Wasps, the Caciques Build Sack-like Nests that Swing from the Branch-tips of the Tallest Trees

LEE S. CRANDALL

IN the dense jungles of Central and South America, few birds are as conspicuous as the tropical members of the oriole group, the caciques. Around the little clearings, in the towering rain forests, even on the mountain slopes their great, pendulous nests are of such frequent occurrence that they seem better than almost any other creature of air or land or water to have proved their fitness to survive and to have found the secret of defying the ever-present forces of destruction.

And in a sense they have. Where enemies abound, the caciques have scorned the devices of concealment of their nests. They nest in the open and in plain view, but with such prudent placement that the most adventurous monkey or opossum or tree-snake dares not attack. Like our northern orioles, the giant orioles of the tropics hang their sack-like nests at the very tips of slender branches, at the periphery of the highest trees.

The nests of several species, in addition, are usually found in close association with those of wasps. As guardians against intrusion they could hardly make a better choice—as every wanderer in the tropics will admit, if he has ever been stung by one of those humming pellets of fire.

Many years ago in a number of *Zoologica* (Vol. I, No. 3) Dr. Beebe commented upon the relations between wasps and caciques.

“But a colony of caciques which chooses to live in the jungle itself would have short shrift, were it not for the strange communal guardianship of the wasps. These insects are usually large and venomous, and one sting would be enough to kill a bird; indeed, a severe fever often ensues when a man has been stung by half a dozen. So the birds must be in some

way immune to the attacks of the wasps. Perhaps their wonderfully complete armor of feathers, scales and horny beak accounts for this, while their quickness of vision and of action enables them to save their eyelids—their one unprotected spot. Although the caciques cannot have learned from experience of the terrible wounds which the wasps can inflict, yet they are keenly alive to the advantages to be derived from close association with them.

“The wasps’ nest is built far out on the tip of the limb of some forest tree, and the long pendant homes of the caciques are placed close to it, sometimes eight or ten on the same branch, and others on neighboring limbs, so near that the homes of insects and birds rattle against each other when the wind blows.

“One such community was placed rather near the ground, where we could watch the inhabitants closely. Frequently when one or two of the big birds returned to their nests with a rush and a headlong plunge into the entrance, the whole branch shook violently. Yet the wasps showed no excitement or alarm; their subdued buzzing did not rise in tone. But when I reached up and moved the branch gently downward, the angry hum which came forth sent me into the underbrush in haste. From a safe distance I could see the wasps circling about in quick spurts which meant trouble to any intruder, while the excited caciques squeaked and screamed their loudest. Whether the slight motion I gave to the branch was unusual enough to arouse the insects, or whether they took their cue from the cries and actions of the alarmed birds, I cannot say.”

In the bird collection in the Zoological Park we are fortunate in having representatives of two species of the giant caciques of tropical



Wagler's Giant Cacique, a magnificent black bird with bronzy head and neck, came unexpectedly into the bird collection last year when an itinerant dealer offered a specimen that he could describe only as a "giant cacique." The Curator took a chance.

America—Wagler's Giant Cacique (*Zarhynchus wagleri*) and the Great Green Cacique (*Xanthornus viridis*). Among the various caciques there are five genera of giants and several more genera of the smaller birds. The genus *Xanthornus* includes thirteen forms. Our specimen of the Great Green happens to be not only one of the handsomest of the species in that genus, but a magnificent specimen in itself—hand reared and in beautiful condition.

In the following pages the display form of this specimen is pictured. Unlike the birds of paradise, the caciques do not have an elaborate display and the three photographs of the displaying bird are simply various positions that happened to be assumed by the bird in the course of its single display form: wings lifted straight up, head and neck lowered.

During the display, or immediately preceding it, the bird utters its characteristic note—a series of short, sharp, chattering and crackling sounds. The late Louis Agassiz Fuertes once described the sound of this call in the deep jungle as being as loud and startling as the noise of a tree falling in the distance.

His description was, perhaps, rather stronger than I should be inclined to make it, but the note undoubtedly is loud enough to be heard above many other jungle sounds.

The nests of the Great Green Cacique, at least where I saw them in British Guiana, were always in small groups of two or three. Wagler's Cacique, on the other hand, usually builds in colonies of ten to twenty nests, although not all of them may be occupied and many may be the nests of the year before. These nests are extraordinarily long—about twenty-eight inches, on an average.

Several species of Giant Caciques have the habit of displaying from the sides of their nests. In full flight as they approach, they will bank and land sideways against the nest, hanging on and going into their display while uttering their harsh cries.

Our specimen of the Great Green Cacique, a male, came to the bird collection on May 13, 1928, as the gift of Dr. H. S. Dickey. Previously we had exhibited several other specimens, having kept one female as long as eighteen years.



(Upper). The Great Green Cacique in a position of rest. (Below). The bird goes into the first stage of its comparatively simple display by bending forward and throwing its wings straight up, while uttering its characteristic chattering sounds.



(Upper). The second stage of the display of the Great Green Cacique, in which the bird begins to lower its body. (Below). The last stage, the cacique holding itself at right angles to the perch, and still uttering its cries.

Quarry of the Camera

The Greatest Thrill to a Lover of Wild Nature Is a Form of Hunting
that Brings Back a Trophy and Leaves the Game Free

BEN EAST

Nature Editor, Grand Rapids Press

IF I were asked to name the most satisfactory way of becoming closely acquainted with any region, with its geography and geology, its climate and terrain, its people and its individual charm, I believe I should unhesitatingly choose camera hunting.

I have spent a fair share of my time the past eight or nine years hunting with camera the wild life of my native state, in marsh and dune-land, forest and field, by boat and afoot and even by air. I know of no other way in which I could have won so pleasant and close an acquaintance with the state, and enjoyed at the same time such a variety of amusing and entertaining experiences. And incidentally, I have taken, in that time, a few trophies I prize more highly than any that could have ever come my way through the use of firearm or longbow—and in taking them I have also left them as free to roam their trails or follow their flightways as before I took their spoor.

Of all my camera hunting adventures I think I shall remember longest, and with the greatest thrill, one that occurred on a July afternoon on Lake Richie, a small inland lake buried in the wilderness of Isle Royale, Michigan's northernmost fringe of rocky land in upper Lake Superior.

Along the shore of a little timbered island in the middle of the lake, well beyond camera range, a pair of big bull moose were wallowing and splashing in indolent contentment, their deep voiced grunting reaching us plainly.

From our hiding place in the alders and tall grass that fringed a narrow arm of the lake we watched them hopefully and a trifle resentfully. We had seen moose aplenty during the afternoon and had photographed several, including

one obliging cow that led her calf back from a swim in midlake to the very spot where we waited for her. But not a single large bull had come our way.

A low splashing at our left attracted Lahti's attention. He nudged me. A hundred yards down the arm a yearling cow had just stepped through the alders into the shallow water. She stood for a minute, looking up and down the shore, dipped her ungainly muzzle for a long drink, taking the water in unhurried, satisfying gulps that were plainly audible to us. Then she waded out shoulder deep and began a combined late lunch and afternoon dip.

We dropped back into the dense forest of spruce and fir and cedar, making a wide circle to come down to the shore again at a point near enough for pictures, and downwind from the cow.

Moose trails ran in every direction through the swamp, like a maze of well worn cow paths, the prints of the big plunging hoofs driven deep into the soft black mud. By keeping to these trails we could move through the timber almost as silently as the moose themselves.

Halfway to the vantage point we sought, a dry stick cracked sharply just beyond a little rise forty or fifty feet to our left. Lahti, ahead, dropped prone behind a fallen log that lay across the moose runway he was following. Saint Germaine and I slipped aside into the shelter of a big clump of spruce trees. Over the crest of the rise came a yearling cow that might have been a twin of the one we stalked.

Either she had heard our light footfalls before we heard her, or some vagrant puff of wind, eddying through the swamp, had carried her a vague warning. She paused only a few yards off and stared fixedly in our direction.

But the eyes of a moose are notoriously bad, save for moving objects, and from where she stood the wind favored us. After a minute she turned, apparently satisfied, and stalked on toward the water.

We waited until she had passed through the fringe of alders, then we resumed our circuitous stalk of the first cow. We came to the edge of the timber, perhaps seventy-five feet from her, and I slipped past Lahti to a hiding place behind the upturned roots of a fallen cedar. Waiting until the heads of both moose were down, feeding in shallow water, I lifted the camera above the stump, in readiness for use.

The animals were drawing together as they fed, promising a picture that would include the two of them. They approached within a few yards, lifted their heads suddenly as if aware for the first time of each other's presence.

I would have given much to know the unspoken challenge, the unvoiced feminine insults that passed between them in that instant. Their ears went back against their heads like the ears of angry horses. Two or three quick strides brought them together and they upreared on their hind legs, almost as erect as two human boxers.

Even in the heat of the brief battle that followed, their movements seemed almost deliberate, giving to the affair a little of the comic effect of a slow motion picture. But the flying spray that enveloped their hind legs as they sparred, and the thud of the blows they exchanged with their forelegs, belied emphatically any suggestion of slowness or comedy.

It was over as quickly as it began. Probably not more than a minute elapsed from the time the first blow was struck until one, vanquished, dropped down on all fours and fled, with the other in vengeful pursuit. Fifteen or twenty feet from the site of the skirmish the victor overtook her foe and upreared to deliver a vicious blow across the back as they ran. The recipient whirled and came erect again in self-defense but the brush was brief this time. In five seconds it was over, with the defeated cow in full flight, the other turning quietly to her feeding again.

In the minute or so the affray had lasted I had managed to trip and reset the shutter of my camera three times. As the two moose came together I jumped to my feet, clear of cover,

risking discovery for the sake of speed and accuracy in focusing. Nor was there any danger they would see me. They were so engrossed for that minute that I suspect a dozen men could have walked out on the shore in plain sight without attracting their attention.

When the affair was finished I dropped down into hiding again, crept back through the fringe of alders.

"Did you get 'em?" Lahti asked anxiously.

Caution born of years of camera hunting and numerous disappointments prompted my reply: "I doubt it. I'll tell you when the films are developed."

"I hope you did," Saint said fervently. "Nobody'll ever believe we saw it, if you didn't."

Development of the films proved my luck better than I had dared hope. I had three exposures, two of them good, the third fair. The two good ones had caught the moose approaching for the battle and at the climax of the episode.

We could find but one woodsman in all the moose-infested wilderness of Isle Royale who had ever witnessed a similar spectacle. As far as I know but one other wild life photographer in North America has ever been fortunate enough to have a chance with his camera such as I had that July afternoon on the shore of Lake Richie. I shall leave him unnamed, for the reason that he used a telephoto lens and a short range focus finder, or the reverse, netting him only a strip of hopelessly blurred film.

My most interesting experience with feathered camera quarry has been, as might be expected, with the bald eagle, emblem of America that graces her coins and the standard of her flag—but by a strange and involved bit of reasoning on the part of her lawmakers enjoys no protection under her laws, save in a few conservation-minded states such as Michigan, and is even the subject of a shameful blood bounty in the largest of American territories.

I found my first eagle nest cradled in the high branches of a lofty oak, on the shores of a lake buried deep in the northern forest. While I was still two or three hundred feet away from the aerie tree the brooding she eagle, scanning the forest aisles about her with her white head raised just above the rim of the nest, saw me and winged up, voicing her resentment and alarm in harsh wild screams.



(Upper). With ears at an ominous angle, the cow moose approach in two or three quick strides. (Below). In striking distance, and the deliberate battle is on.



From her aerie in a lofty oak the eagle spied the author far away.

Her mate answered from his lookout perch atop a dead spruce a hundred yards from the aerie, but he did not take wing at once and I was given an excellent chance to study him through my binoculars. His head and tail were as white as new snow and his fierce yellow eyes, under their beetling white brows, never left me. The golden scimitar of his bill opened time after time as he screamed his rage at this alien who had intruded upon the solitude of the forest, and all in all I believe he was the most impressive picture of regal anger I had ever seen.

He soared up when I approached nearer his aerie, and when I stood at the foot of the big oak the two eagles hung in the air two or three hundred feet overhead, turning in short circles and still screaming.

I confess it was with some misgivings that I buckled on my steel climbers and adjusted my safety ropes. I could have lain outstretched across the full spread wings of either of the birds that wheeled above me, and I knew that if they came down to defend their nest I should have scant chance of beating them off from my precarious position in the tree without considerable damage to my own person.

My apprehension was quite unwarranted, however. As I began the climb to the huge nest the eagles mounted higher in the sky until they were a full thousand feet above me. From that height they continued to voice their displeasure but they came no nearer, even when I stood beside the aerie.

The nest was an old one, bulking five or six feet high and nearly as wide at the top, built solidly of dead branches, some of them as thick as my wrist and four or five feet long. So sturdy was the structure that I later stood erect on one side of it. At the center was a neatly hollowed lining of soft grass and in the hollow lay three large white eggs.

Fearful of causing the eggs to chill I made my visit a brief one, that first day, hurrying down as soon as I had made the pictures I wanted.

Some two weeks later I went back to find three down-clad eaglets in the nest. They were not all of a size, the result of the she eagle's habit of beginning to brood as soon as her first egg was laid. Two of them were large enough to stand erect and move about the nest. The third lay helpless on his bed of dry grass.



(Left). The female eagle returns to her nest with a mighty beating of wings. (Below). The author reconnoiters the nest from an adjacent limb.



Across the back of the nest was stacked a food supply sufficient to last the family for several days, consisting entirely of fish. The largest of the lot were suckers measuring more than a foot in length. I estimated there were between ten and fifteen pounds of fish, stacked rather neatly on one side of the nest, and partially covered with clusters of green pine needles, obviously gathered and brought there for that purpose.

I have speculated much about these pine needles. They were the only green material I found about the nest, and whether they were used with the idea of hiding and protecting the fish or from some dim, strange instinct beyond my understanding, I am unable to venture an opinion.

While I worked with my camera above the nest that day one of the adult eagles, I believe the female, came close to me for the first and only time. She came swooping down and passed through the branches of the tree, so close above my head that I am sure I could have touched her by reaching up a hand. She did not scream, did not threaten attack. Only swept over me on great spread wings, turned



(Upper). When this picture was taken there were three unhatched eggs in the nest, softly cushioned on dry grass. (Lower). And then came the day when the camera caught the first eaglet out of the egg—and the remains of his first fish dinner.



Two downy eaglets out of the egg, and one more to come. They hatch at different times because of the eagle's habit of beginning to brood as soon as her first egg is laid. A short time later the third egg was hatched and the family completed.

just beyond the tree and came back, passing above me three times, while I shrunk back among the branches and pretended not to see her. What her purpose was, save perhaps to frighten me away or to see whether I really meant harm to her young, I do not know. After the third passage she circled up into the sky to rejoin her mate, and never again, on all the visits I paid her nest, did she come within a hundred feet of me. Nor have I ever seen another eagle do what she did, and I have intruded on the privacy of nearly a dozen pairs.

In early June, when the young eagles were fully fledged, I went back to the aerie once more, this time to attach to their legs the numbered aluminum bands of the United States Biological Survey.

I think nothing I have ever done with birds has afforded me the thrills I got from holding those young eagles in my hands that day while I fitted and made fast their bands.

When my head and shoulders appeared above the rim of the nest they displayed an amusing mixture of surprise, fear and resentment. Obviously they had never seen anything like me

before, and instinct or perhaps the cries of their parents ringing overhead, warned them I was an enemy.

They ruffled their feathers until they bristled like angry dogs. Their sturdy wings, already spreading some five feet, were half opened like shields to fend off an attack. Their powerful beaks, that in a few more weeks would be capable of rending a three-pound fish from gills to tail at a single stroke, were opened threateningly and they broke forth into savage hissing and guttural croaking.

Caution mixed with their rage, however, and they promptly backed away toward the farthest edge of the nest, until I was afraid they would topple backward and, falling on untried wings, perhaps seriously injure themselves.

Moving as carefully as I could I reached out a hand for the nearest. He jabbed sharply at me with his beak and backed farther away. Still moving quietly I took off my soft felt hat, reached around behind him and dropped it lightly over his head to serve as a blindfold. With the other hand I lifted him by the feet and drew him to a place of safety in the center

of the nest. When I uncovered his head he sat quietly there, regarding me with what seemed a new air of respect and confidence. I rescued the others with the same ruse, fitted the bands on to their legs, and locked them in place with light pliers.

When I had finished the three of them sat there, almost at my knees as I knelt on the edge of the big nest, their suspicion and fear apparently largely allayed. They paid little attention to me or to my camera, only croaking half heartedly when I moved. I reached out a hand and stroked their wings and they did not bother to back away. For that one minute in their wild, free-born lives these young sky kings had had friendly contact with their worst enemy, man, offering no objection to his overtures.

It was with a decided feeling of regret that I clambered down over the rim of the nest and dropped out of their sight. Wild eagles, soaring free above mountain, valley and winding

river, rising out of mist-blanketed lakes in the dawn, do not come down and allow men to read the numbers of metal bands on their legs. When next I had news of this brood, I knew, it would be that their days in the wilderness were at an end, that misfortune and probably death had come to them.

That was in 1927, and no word has been heard of them since. Of three I banded in 1928, however, in aeries about fifty miles distant from this first one, two failed to survive their first winter migration.

These eaglets were banded late in May. The following January I received word that the first had been killed near Lexington, Kentucky, and two weeks later came a report that the second had met a like fate at Reelfoot Lake, Tennessee. These were, I believe, the first long-distance return records on the bald eagle ever reported to the Biological Survey from its bird-banding operations.



Putting U. S. Biological Survey bands on the first bald eagles banded in Michigan.



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All pictures not otherwise credited are from the photographic collection of the New York Zoological Park and the Aquarium.

NOTES FROM THE ZOOLOGICAL PARK AND THE AQUARIUM

The Wattled Crane

As frequently pointed out in the pages of the *Bulletin*, there are many stock rarities which every Curator would like to add to his collections. As the years go by, the list assumes a position apart, almost inviolate. When one of the items is actually checked off, there is joy, of course, but there is also a tinge of something like regret. For the members of this group have become part of our imaginations, not real creatures of flesh and blood!

The Wattled Crane (*Bugeranus carunculatus*), of South and Central Africa, has long held a high position among the birds we never expected to see. Even in its native land, it is far from common; I cannot recall a single specimen ever offered for disposal. Now and then, it has appeared in Europe but never was there any possibility of the bird going farther.

In 1936, Mr. Albert M. Vida, of the *M/S City of New York*, who has brought us many fine things from South Africa, returned from one of his long voyages with word that he had had an opportunity to secure a Wattled Crane but that a change in the ship's sailing schedule had prevented his doing so. This was a great disappointment to us, of course, but our chagrin was intensified when, a few weeks later, a Wattled Crane, which we had every reason to believe was the same bird, was obtained by a New York dealer. We might have secured it then but its value had increased so much during its travels that it seemed wiser to risk getting another from the same source. So America's first Wattled Crane went to Chicago's Brookfield Zoo, where it is an outstanding member of that already fine collection.

So the Wattled Crane remained on our hope list. But not for long. When the *City of New York* tied up in Bush Docks, on May 4, 1937, a Wattled Crane was numbered among the living creatures in the care of Mr. Vida. That evening, when he reached the Zoological Park, the crane was wobbly of leg and dull of eye, but a handful of earthworms and a night's rest restored him completely.

Usually, when long awaited specimens finally reach us, they fall a little short of our expectations. They are in dull, immature plumage, they are very young and perhaps difficult to rear, or they are in poor condition. But there are no drawbacks to our Wattled Crane. He is taller by several inches than we had thought he would be; his plumage, even to the long, tapered secondaries of the wing, is immaculate; his health is perfect. Moreover, he was evidently reared by hand, for while he is fully adult, he is tame, gentle and fearless as on the day he was hatched. Perhaps this picture is too perfect. Perhaps we should place a tiny smudge upon it. The wattles—visitors are already asking about them. For they are but tiny, double rolls of skin, barely an inch long, feathered at the back, with a snip of reddish skin at the front. For a bird that is so tall and stately, they seem too small and insignificant to have given him a name. But the fact remains that they did!—L. S. C.

Fish Longevity

There are a number of records on the life-spans of many of the more usual fishes in the Aquarium, but some have not yet been reported, among them a few of the fishes not usually carried in aquaria, either because they are sufficiently rare as to be scarcely considered at all, or else because they live for such a short while after being captured that any record would be obviously incorrect. However, we now have records on two species of Four-eyed fishes. *Anableps anableps* lived for nine months in the Aquarium and *Anableps dowei* for eleven months and 12 days. A Mudspringer, *Periophthalmus koelreuteri*, lived for three years and two months. *Toxotes jaculator*, the Archer fish, lived for twenty-two months. There are two species of Characins, not usually considered long-lived, which were acquired full grown in November, 1931, and which are still alive. These are *Pristella riddlei* and *Hemigrammus caudovittatus*.—C. W. C. & J. W. A.

Big Trout from Kensico

That large lake known as Kensico Reservoir, of great importance to the New York City water supply, has long been a favorite fishing site of the local fresh water anglers. Enlarged in 1916 to its present size, it has supplied bass fishing for a long period. Although it was known that lake trout had been planted in the reservoir, and that occasionally workmen saw traces of them, it was not until 1935 that anglers made any concerted efforts toward their capture. None was taken prior to this, since the trout were naturally confined to the deepest and coolest portions of the reservoir, whereas angling for other species had always been carried on in the shallow and warmer surface waters. However, with appropriately



Curious visitors and marauding small boys make it difficult for the Canada geese to produce families in the Park, but Keeper McBride "rode herd" on this family until three goslings were duly hatched. Subsequently, however, another pair of Canada geese on Lake Agassiz "kidnaped" one of the goslings for its own family.

rigged gear it was found by various anglers that in depths of forty feet and more, lake trout of good size could be caught. Thus, a new local outlet for sporting proclivities was established.

These fish feed on the abundant alewives which have been the subject of other remarks in these pages.¹ It is not surprising, as a consequence, that when the latter drop downstream, as they do in winter, the trout follow along with them. At any rate the alewives accumulate on the outlet screens of the reservoir and periodically have to be removed. Every once in a while a lake trout is likewise so caught. The writer has seen several of these, of no especial note, but one which appeared this year is of some topical interest. This, the largest lake trout recorded for Kensico Reservoir, measured 36 inches over all, 31¾ inches to base of tail, and had a girth of 21½ inches. It proved to be a male of 20 pounds.

An attempt was made to determine the fish's age by an examination of the marks on the scales. This scale reading indicated that it had been hatched in 1928. Compared with two caught by anglers last summer, which showed 1928 and 1927 as respective birth years, the present would seem to be of the same lot. These figures are not to be taken too seriously, however, as the scale markings were difficult to interpret. Game Protector E. T. Townsend reported in a letter that lake trout were stocked in Kensico in 1884,

again in 1910, and intermittently during the succeeding years. He wrote further: "About 1926 or 1927 there was a stocking of lake trout six or nine inches long put in this lake. All other stockings previous to this were of very young fry." It is interesting to speculate as to whether these fish were of the last stocking, miscalculated by one or two years, or whether they were spawned in the lake—the offspring of some previous planting. It would be worthwhile to attempt to determine if these fish are actually reproducing here.

Although Kensico is rather far south for lake trout, the conditions are somewhat unusual, as Deputy Commissioner Herman Forster has pointed out, since most of the incoming water flows through an immense tunnel from the more northward Ashokan area.—C. M. B., Jr.

Poisonous Snakes in India

It has become almost a standardized thought in figuring annual casualties in India from disease and attacks of wild beasts, that poisonous snakes kill about twenty thousand humans a year. Such figures seem appalling. They sum up to close to a quarter of a million deaths from snake bites in ten years' time. There are several circumstances surrounding the allegation of this death rate which are not generally understood.

In the first place, the population in the area under consideration is close to three hundred mil-

¹ Forster, H. Fish in the Faucets. *Bulletin*, 1935, 28 (4): 139-142.

lion humans. Secondly, a considerable portion of the figures is swung in by estimate. Also it is possible that ordinary septic wounds, resulting fatally upon careless natives, are often attributed to snake poisoning. With the advent of antivenomous serum and more careful tally, if that is possible, the writer figures that the oft-repeated "twenty thousand the year" could be more than cut in half. Even at that, and with the heavy figures of population, an annual death rate of ten thousand a year would be heavy as compared with other tropical countries, but it will probably be always rather heavy in India owing to the utterly careless or fatalistic disposition of a large part of the native population. Africa has a very low mortality from snake bites, but the members of the greater number of African tribes are woodsmen, keen, alert and sensing the life and sounds of trails and jungles.

An incorrect idea about deaths from snake bites in India is that they are mostly caused by the cobra. In reality there are four types of snakes in India producing the annual mortality figures and it is doubtful if even 25 per cent. of the blame can be laid to the cobra.

The three worst offenders are the carpet viper, the Russell viper or tic-polonga, and the kraits—there being two species of the latter. The big king cobra of eastern India and Malaysia figures but superficially in producing human casualties

in relation to the alleged figures. The carpet viper is a small, grayish snake ranging eastward into India and Ceylon. Its average length is about two feet, but it has a fiery temper, is unpleasantly numerous, strikes at the slightest provocation and its venom, drop for drop, appears to be of higher toxicity than any of the other Indian snakes. The Russell viper is quite a large snake, attaining a length up to four feet, is thick of body, quick to strike, secretes a powerful poison and owing to its size injects considerable quantities.

The kraits are of a very different kind. They are elapids, of the cobra clan, but of all poisonous snakes are singularly quiet and inoffensive—unless stepped on. The banded krait, brightly ringed with black and yellow, has a habit of sprawling across dusty roads at night. Being a night prowler and coming to such spots which continue to radiate warmth from a sun-baked surface, these snakes are stepped on by natives who make visits after dark from one village to another. The venom of the krait, which is of a neurotoxic type, is more powerful than that of the cobra.

It is of interest to note that four types of the poisonous snakes of India are now on exhibition in the Reptile House at the Zoological Park. These are the banded krait, the spectacled or common cobra, the king cobra and the Russell



At this season of the year, when the magnolias are in blossom, the thick plantings at the west end of Cope Lake are a white cloud of blooms. During the next two weeks the large flowering shrubbery in the Park will be at its best.

viper or tic-polonga. The latter species has figured in the writings of Conan Doyle, particularly in his vivid story of "The Speckled Band," in which a tic-polonga played a villainous part and was detected by Sherlock Holmes.—R. L. D.

Emergency!

The harmless and economically useful milk snake is often mistaken for the poisonous copperhead by persons unfamiliar with the exact markings of the two serpents, and frequently is given a sinister reputation it does not deserve. Confusion of the two snakes caused excitement on Sunday afternoon, May 23, when a fourteen-year-old boy was bitten by a milk snake on the Palisades near Fort Lee, New Jersey, and was hurried to the Zoological Park with a police escort for an injection of antivenomous serum.

Fortunately the boy's companions had killed the snake and the carcass was brought along. Head Keeper Toomey in the Reptile House took one look at it and set all fears at rest by pronouncing it a milk snake, and its bite of no consequence.

The boy, with several companions, was collecting wood on the Palisades when the snake bit him on the left forefinger. Stopping only long enough to kill the snake, the boys ran to a highway and hailed a radio patrol car. The patrolman

also thought the snake looked like a copperhead, and took the boy and the snake into his car and shot away to Englewood Hospital where the tiny wound from the snake's teeth was cauterized.

The New Jersey policeman then delivered the boy and the dead snake to the Wadsworth avenue station in New York City, from where a phone call established the fact that the Zoological Park had a supply of fresh antivenomous serum. Another radio car rushed the boy to the Park, where the adventure quickly ended.

PUBLICATIONS OF INTEREST

WHO'S WHO in the ZOO: Natural History of Mammals. Federal Writers Project, City of New York. Halcyon House, N. Y., 1937. \$1.67.

There has long been a place for such a book as "Who's Who in the Zoo." The educational possibilities of a similar volume, illustrated by the Zoological Society's superb photographs, has not been overlooked by the Society but lack of private funds and personnel have prevented publication by that organization.

A statement on the jacket to the contrary, the text material was apparently not checked by competent mammalogists, for a number of inaccuracies, near-truths and misstatements have slipped through. In the main, of course, the material collected by the various writers involved is true to nature and interesting but occasionally one has gone "haywire." Thus practically the entire discussion of the giant panda, for the sake of accuracy, could better have been omitted. It is true that any animal with a penchant for raiding village pantries is liable to wind up in a zoo but in this case the giant panda has been confused with the little panda, an entirely different animal, and our zoos still keep the name giant panda at the top of their list as the rarest of all mammals in captivity.

Modern ways and lack of restraint have filtered into chimpanzeeland and we find them beating hollow log-drums with wild abandon, "stomp" dancing their way through tropical forests and inevitably, but unbiologically, bringing forth young once or twice a year!

These are perhaps the two most evident inaccuracies noted in the text. In general the job of editing has been a good one and misspellings, so often noted in works of this kind, are conspicuously absent. (In this connection the reviewer does not recall ever seeing the word raccoon spelled with one "c" in any work on mammals—the dictionary to the contrary). Included inaccuracies generally bring out the fact that books on mammals should be written or thoroughly checked by persons trained in mammalogy.

The black and white range maps do not seem to add anything to the text, in that they fail to illustrate accurately the ranges indicated and lack originality since too often the figure on the map takes exactly the same stance as the illustrating photograph.

However, as previously stated, "Who's Who in the Zoo" fills an existing need. All in all, it is well done and mistakes occurring in this edition can easily be corrected in subsequent printings.—C. W. L.



A handsome specimen of the saddlebilled stork from Africa, recently brought to the Zoological Park by A. M. Vida.

Serpents of the Northeastern States

By RAYMOND L. DITMARS

HERE is a comprehensive, yet compact, book about the snakes of the northeastern states that will prove to be extremely useful to everyone with a summer home or camp in that region. This guide to the venomous and non-venomous reptiles of the New England area, New York, New Jersey and eastern Pennsylvania, is a practical and handy reference work. It gives a key for ready identification of snakes, descriptions of their feeding and breeding habits, notes on distribution and photographs of every species found in the northeastern states, including color plates of the copperhead and rattlesnake. One section is devoted to the emergency treatment of snakebite.

"Serpents of the Northeastern States" was originally published as a complete number of the BULLETIN and several reprintings were quickly exhausted. It has been republished in a new format, somewhat revised as to text and nomenclature, and four photographs have been added.

60 pages, 41 illustrations.

50 cents postpaid.

Department of Publication & Photography
NEW YORK ZOOLOGICAL PARK
185th Street & Southern Boulevard
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PUBLICATIONS

Free to Members:

Bulletin: The official publication of the New York Zoological Society reports bi-monthly on interesting phases of work at the Park and the Aquarium and contains articles on natural history in a sound yet popular form, with many illustrations. Thirty-eight volumes have been completed.

Zoologica: Scientific contributions of the New York Zoological Society. Volumes I-XIX and Volume XXI are complete, and Volume XX is in preparation. Volume XXII will be issued during 1937, in quarterly parts. *Zoologica* is sent to Members on request.

[*Zoopathologica*, Scientific contributions of the New York Zoological Society on the diseases of animals, has been discontinued and future papers on animal pathology will appear in *Zoologica*. *Zoopathologica* is complete in Volumes I and II, which are indexed.]

Annual Report: Documents, reports and pictures of the work of the various departments of the Park and the Aquarium. As a rule it contains articles of scientific value and considerable general interest.

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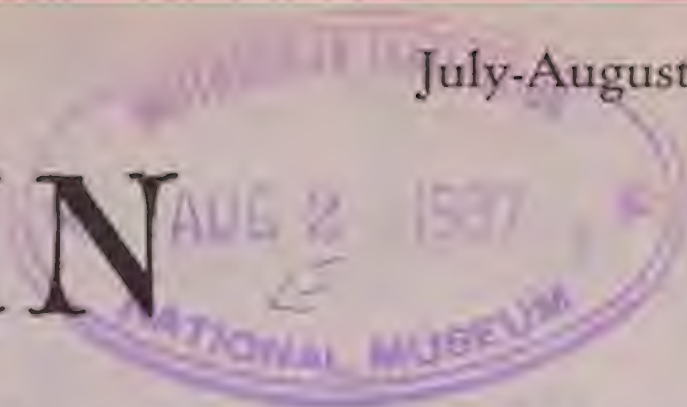
A classified list of the publications of the Society, with subject headings of articles printed in the *Report*, *Zoologica* and *Zoopathologica*, as well as reprints from them, will be furnished on request. Some of the publications have become exhausted and orders for any issues will be governed by this circumstance. Orders for any of the publications should be addressed to H. R. MITCHELL, Manager, Zoological Park, 185th street and Southern Boulevard, New York City.

No effort will be spared to ensure delivery of the regular publications to Members of the Society, but changes of address, forwarding points and non-delivery of mail should be reported promptly. Back numbers of *Bulletin* still in print will be supplied to Members and others at the rate of 30 cents each. Postage and handling, 5 cents extra.

Clark and Fritts, New York, Printers.

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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

Annual Membership in the Society is \$10, renewable annually. Life Membership may be obtained for \$200. A contributor of \$1,000 becomes a Patron; \$2,500 an Associate Founder; \$5,000 a Founder; \$10,000 a Founder in Perpetuity, and \$25,000 a Benefactor.

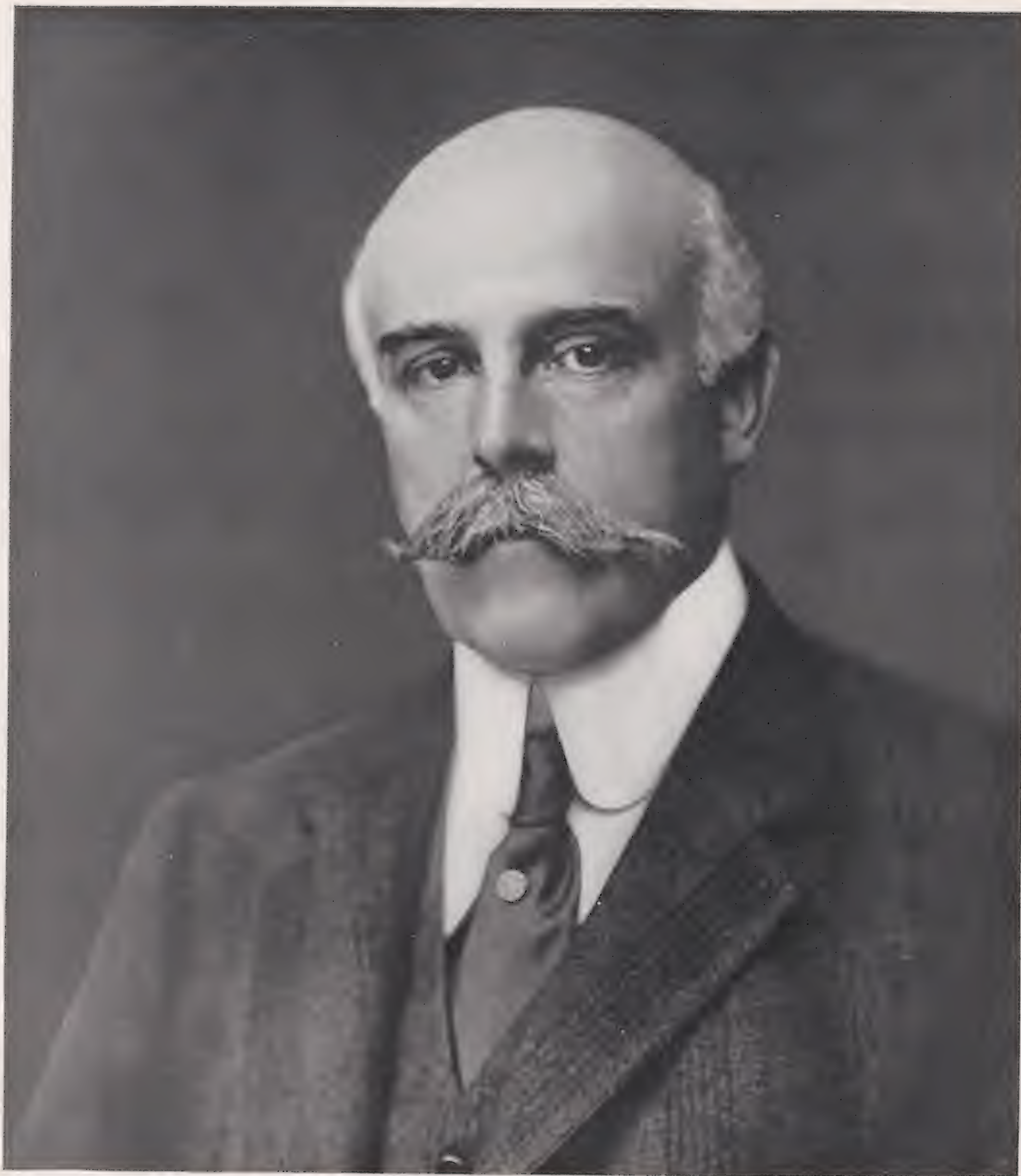
All classes of Members are entitled to receive every periodical publication, the privileges of the Administration Building with its lounges and reception rooms and gallery of paintings of animals, to attend lectures, open meetings and entertainments, and to be admitted free to the Zoological Park and the Aquarium every day in the year.

Application for Membership may be given to the Director of the Zoological

Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 101 Park Avenue, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



Madison Grant

1865-1937

President of the New York Zoological Society, 1925-1937

Secretary, 1895-1925

Second Vice-president, 1915-1916

Chairman, Executive Committee, 1909-1937

First Vice-president, 1916-1925

BULLETIN

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A Tribute to Madison Grant

MADISON GRANT was born November 19, 1865, and died May 30, 1937. Between those dates was compressed a life of accomplishment beyond the ordinary. Endowed with a splendid body and unusual vitality, he had also a powerful and penetrating mind and an inquiring disposition which led him to form his own conclusions on the questions which confronted him.

From his earliest days he had been a lover of animals, and after graduation from Columbia University Law School in 1890, the vision of a great Zoological Park in New York City gradually formed itself in his mind. Undeterred by difficulties and undaunted by obstacles, he persisted with his plan until the New York Zoological Society was chartered in November, 1895. From this date until his death he was the mainspring of the institution and labored unceasingly to expand its scope and increase its usefulness.

From the beginning he insisted that the proposed park should be a free institution, laid out on a large scale; that it should occupy an extensive forest area which should be developed in a manner to retain its natural character, giving each type of animal exhibited, as far as possible, something akin to its own natural habitat.

This park was conceived for the benefit of the millions of people who would there find recreation and entertainment, as well as instruction of an educational and scientific nature.

To those who worked with him in the Society this accomplishment will always be first re-

membered, although it is only one of his many activities which enriched the city, state and nation.

As President of the Bronx River Parkway Commission, Madison Grant devoted his vision, energy and talents to the completion of this great Parkway, which has served as an inspiring example of what can be done by the wise application of combined science, art and beauty when conceived by men with civic pride and enterprise.

Following his work on the Bronx River Parkway, his experience and wisdom were sought by the state in connection with other similar projects, and since 1924 he was a member of the Taconic Park Commission.

Madison Grant had a wide scope of intellectual avocations, having served with distinction on the Boards of such organizations as The American Museum of Natural History, the American Geographical Society, the National Institute of Social Sciences, the Immigration Restriction League, and other scientific and cultural organizations. As President of the Boone and Crockett Club, founded by Theodore Roosevelt in 1884, Madison Grant was in a position to make his influence felt in the cause of conservation of wild life. It is safe to say that no individual has obtained greater results in this direction during the last forty years. His interest in living things was not restricted to animals, and the approaching doom of the California redwoods awoke his fighting spirit so that in 1919, with Professor Osborn and Dr. Merriam, he formed the "Save-the-Redwoods League," which

after many years of persistent effort has so roused public opinion as to procure the setting apart of many groves of these magnificent specimens, which for hundreds of years will stand as living monuments to the man who made their continued existence possible.

Space does not permit an enumeration of Madison Grant's extensive and varied interests, but the world is fortunate in having a portion of his encyclopedic knowledge of ethnology preserved for all time through two of his many writings. In "The Passing of a Great Race" and "The Conquest of a Continent" we have become the possessors of the results of a lifetime of patient inquiry and brilliant diagnosis. The facts are dogmatically stated and have aroused much discussion, but their accuracy has never been successfully disputed and many of the wisest experts have agreed with the conclusions drawn from the facts.

Belonging to a type of vigorous, tireless and trenchant leadership, Madison Grant's information on scientific matters made possible the forming of clear and sound opinions which were highly valued by his associates. Possessed of a keen and well-trained mind, he quickly grasped the underlying principles of a problem, and his judgment was frequently expressed with a dash of humor that was always clarifying.

Although a lawyer by profession, he was primarily interested in zoology, and by reason of his wide experience in exploring and hunting in the United States, Canada, and Alaska, he became aware of the rapid disappearance of many forms of wild life and the destruction of once abundantly forested areas. He early recognized the need for the establishment of sanc-

tuaries and refuges for big game animals if these were to be saved from complete extermination.

Of Madison Grant's many admirable characteristics, none was more outstanding than his courage, and this flame never burned more clearly than in his closing years when, wasted by disease, he continued steadfastly on his way, determined that his spirit would not be conquered by the physical degeneration which he could no longer control. Fortunately, one's length of life is not measured by the sum of the years, but rather by the character and accomplishments of a lifetime. The absorbing mission of Madison Grant from the time he graduated from college was always that of saving for posterity all the fine, noble and worthwhile things his generation had inherited, and this same urge continued up to the end of his life as if all these were his personal responsibility. Measured by these standards, he served his generation well, leaving us a heritage which should incite our emulation and direct our endeavors.

At the funeral services held at St. Bartholomew's Protestant Episcopal Church, the Rev. George Paull T. Sargent, Rector of the Church, read the last verse of the sixth chapter of the Second Book of Maccabees, which was particularly appropriate to Madison Grant's earthly career. It reads: "And thus this man died, leaving his death for an example of a noble courage, and a memorial of virtue, not only unto young men, but unto all the nation."

To those who worked with him, Madison Grant's memory will always be an inspiration, and they will think of him as a great conservationist, a great citizen and a great gentleman.

W. REDMOND CROSS



Protective coloration and mimicry combine to make the whip-poor-will invisible to all but the most painstaking scrutiny as she hovers her fledglings on the leaf-strewn forest floor. The author stood for ten minutes within two yards of this bird and scanned the ground inch by inch before he was able to separate her earthy colors from the forest debris.

Their Colors Hide Them

Some of the Ground-nesting Birds So Perfectly Accord with Their Surroundings that They Are Almost Invisible

BEN EAST

Nature Editor, Grand Rapids Press

PROTECTIVE coloration and protective mimicry are interesting devices.

They serve equally well the tiger, crouched beside a game trail that leads to a jungle water-hole, and the defenseless varying hare, hunched in his winter form beneath a snow-hung fir tree.

They befriend alike the walking-stick, swaying at the tip of a hazel branch, and the leopard frog, motionless among the grasses of a lowland meadow while a marsh harrier cruises overhead on wide wings.

Nowhere, it seems to me, are they more interestingly demonstrated than in the plumage of certain ground-nesting birds. I believe the most striking example of protective coloration and mimicry combined I have ever seen was a mother whip-poor-will, hovering two fledglings on the leaf-strewn forest floor.

So perfectly did she match the dull hues of her surroundings, so closely did she resemble a weathered gray-brown knot, that I stood

within two yards of her for fully ten minutes, knowing almost certainly that she was near at hand and within plain sight, but utterly unable to separate her outlines from the woodland floor.

The whip-poor-will is known to all who frequent the woods of the eastern United States, the unfailing nocturnal companion of those who camp in our northern wilderness. From late April through June, in the latitude of the Lake States, it sets the night-blanketed woodland aisles pulsing with its mysterious, cadenced calling. Its cry is as widely known as the caw of the crow, one writer has observed. Yet few indeed are those who have seen the bird, and far fewer those who have looked upon its eggs or young.

It was entirely by accident that I had the good fortune to find a nesting whip-poor-will.

I had paid a visit to the aerie of a pair of bald eagles, on the Little Muskegon river in western Michigan, that May afternoon. I was walking back to the highway through an open



No pretense of a nest sheltered the two creamy-white eggs lying there on the dead leaves. Not even a shallow hollow in the ground had been sought out for them, and their light color, with brown and lilac markings, made them easy to see in such an unprotected spot. Had the whip-poor-will been on the nest, it would have been quite another story, however.



After the eggs had hatched, the mother was flushed and her ghostly, silent flight uncovered two downy, yellowish young whip-poor-wills that were themselves excellent examples of protective coloration as they huddled together on the oak leaves, only betraying themselves momentarily by opening their wide mouths as the heat of the June sun set them to panting.



The warm buff and umber, russet and black and gray tones of the woodcock's plumage match almost perfectly the colors of the dead leaves and the woodland litter around her as she holds steadily to her nest, unconcerned by moving figures and the proximity of a clicking camera. Apparently she believed that as long as she refused to move, she would not be discovered.

woods of scrub oak, popple and jackpine. I all but stepped on the two creamy white eggs, lying there on the dead leaves.

No pretense of a nest sheltered them. They did not so much as lie in a shallow hollow of the ground. They were beautifully marked with brown and lilac, but their whitish color made them easy enough to see in their unprotected location. Not so much as the branches of an overhanging bush screened them.

Had the mother whip-poor-will been on the nest at the time I would have stepped literally over her, less than a yard distant, and gone my way, never suspecting her presence.

It was a week before I could go back. I had photographed the eggs without disturbing them in any way and I felt reasonably confident they would not be moved.

They had lain within a few feet of a weathered pine stump. I found the stump without difficulty, and standing beside it I went over the ground where the eggs had been, foot by foot and inch by inch. Whatever was there now, eggs or young, would be hidden beneath the mottled breast of the mother bird, I felt sure.

I scanned the entire area within eye range for long minutes, gave up, made a series of slow, widening circles around the stump. When I found nothing I came back, tried again, and at last the gray and brown knot—or the handful of dead leaves—lying just beyond arm's reach resolved itself into the object of my search. But even after I located her the resemblance to a bird was far fetched, and she faded repeatedly into her background.

I moved near enough at last to flush her. She



Wildflower pickers came upon the brooding woodcock and she fluttered off reluctantly, feigning a broken wing in order to lure them away from the vicinity of the nest where she was brooding four mottled eggs. They lay warm and inconspicuous in a snug leaf-lined hollow at the foot of a small aspen, among the greens and reddish-browns of a carpet of wintergreen.

was gone in ghostly, silent flight, uncovering two downy, yellowish young whip-poor-wills that were themselves excellent examples of protective coloration as they lay there on the dead oak leaves, but betrayed themselves by opening to full width their gaping, cavernous mouths when the unaccustomed heat of the June sun quickly set them to panting.

I still recall that mother whip-poor-will as the most perfectly camouflaged thing I have ever searched for upon the forest floor.

Next to her I believe I must rank a nesting woodcock upon which we spied one cold windy day in early May.

Wildflower pickers, searching for trailing arbutus, had sent her fluttering reluctantly from her nest the day before, feigning a broken wing to lure them a safe distance from the spot.

One of them guided me back, camera-laden.

There was a threat of cold rain or belated flurries of snow in the overcast skies and the north wind was unseasonably bitter. I have always believed that was why the woodcock, when our eyes finally traced her outlines in a snug leaf-lined hollow at the foot of a small aspen, was brooding with her head turned backward and her long bill hidden beneath the feathers of her back.

The woodcock uses its bill to probe deep in the black soil of alder bogs for earthworms, a favorite food. The bill tip is soft and moderately flexible. What more logical than to believe that it is highly sensitive to cold and that the mother woodcock was hiding it from the chill wind that day, as a small boy crams his hands into his pockets?

We made pictures of the bird, brooding in her queer pose, with our cameras less than a yard from her. She sat motionless, unflinching, never betraying her presence by the slightest movement. Not even an eyelid flicked down.

Nor was her confidence unwarranted. The warm buff and umber, russet and black and gray tones of her mottled plumage matched almost perfectly the colors of the dead leaves and woodland litter around her. Not even the dull greens and reddish-browns of a thick carpet of wintergreen all about the nest tended to betray her.

A hand brought down to within a foot of her head failed to shake her courage and apparent belief that she was undiscovered.

We finished with our pictures and went away for half an hour, to give her a chance to get her head turned around in a normal position. But when we returned she had not stirred so much as a feather. We spent more than two hours in the vicinity of the nest but the woodcock declined to take her bill out of its warm hiding place, and we were obliged to go back another and sunnier day to picture her in a more conventional woodcock pose.

All who have been fortunate enough to see the members of the grouse family brooding on their ground nests know how perfectly their coloration secretes them. Hunters who fare forth into the frost-painted uplands in autumn in quest of the lordly ruffed grouse, acclaimed by a great host of sportsmen the king of North American game birds, hardly realize how much they owe to the rich but somber plumage of the hen grouse. Without it the broods of young "partridges" hatched from sets of buffy eggs in leaf-lined woodland nests would doubtless be far fewer.

Nor does the ruffed grouse need to wait for maturity before being served well by his clan colors. There are few things in the world harder for the eye to find than a scattered brood of grouse chicks, hiding among the dead leaves at a sharp warning note from the wary old hen.

I recall a brood we found one June morning, my friend, Walt Hastings and I, along a rutted, winding sand road deep in the north woods, where we drove in search of the nest of a pair of loons.

The male and female grouse are not often seen together after the young are hatched and

led from the nest, but they were traveling in company that morning, watching together over the chicks. They crossed the road just in front of our car, with the brood between them, a scurrying flock of golden-brown atoms.

Hastings braked the car to a stop and we stepped down as quickly as we could. The male grouse thundered up with a roar of wings and a flurry of dry leaves. The hen bird went fluttering and rolling off across the forest floor, feigning injury after the fashion of so many birds seeking to lure an intruder away from their young.

We stood stock still, searching the sweetfern thickets at the side of the road for some sign of the animated fluffy balls that had raced across in front of us a minute before.

Without moving from our tracks we went over the ground around us with our eyes, inch by inch, scanning each hiding place among the leaves and grasses. Somewhere within a dozen yards of us, we knew, more than a dozen grouse chicks were hiding by the simple expedient of remaining as motionless as the leaves among which they skulked.

Convinced finally that our eyes were not equal to the task, we went down on our hands and knees and began a systematic search of the ground, brushing away the loose leaves ahead of us with gentle sweeps of our hands to avoid crushing young grouse under our knees as we crept along.

We spent perhaps ten minutes in a vain search and gave up. We would move the car down the road a hundred yards or so, we decided, return and hide behind a log or some other convenient cover and watch the hen grouse come back for her skillfully hidden brood.

Hastings climbed into the car, started it, drove it ahead—and there in the middle of the sand road, between the wheel tracks, sat one lone grouse chick, looming up, once the car was moved, like the proverbial "sore thumb."

He had been there in the open road with no cover about him at all when his mother's sharp command to "freeze" reached him, couched in whatever urgent language grouse chicks understand best at such a time. He had stopped in his tracks, flattened on the bare sand, and there he had stayed while the car rolled over him, dry sand flying from beneath the brake-locked wheels. There he had stayed, too, while we

searched the bordering roadside, while the engine was started directly above his head with a terrifying racket, and while the car was rolled forward until he was no longer beneath it.

We gathered him up, hid him under a hat and, heartened by our find, we took up the search again. Presently I brushed something warm and soft and alive in a handful of dead leaves, and in the next ten minutes we found a total of seven grouse chicks.

Some of them we photographed where they were huddled on the leaves in plain sight, but hidden incredibly well. Finally we gathered up the lot, carried them out to an open sunny place on the road and posed them in an arranged setting of leaves and forest debris.

When the pictures were printed I had difficulty myself in accounting for as many young grouse as I knew were there.

Before we returned the chicks to the woods we arranged the lot of them in a row, like toy soldiers, on a white cloth. Nowhere in the world could they have shown up more conspicuously, yet their steadfast courage never faltered. They had been commanded to "freeze" and

freeze they did, unflinching in the face of clattering camera shutters.

We put them back where we had found them then, moved the car down the road, went back and hid to wait the return of the mother bird. She was not long in coming. She materialized out of the undergrowth without warning, and for perhaps three or four minutes she walked back and forth through her hidden brood, clucking softly, as if making sure the coast was clear. During that time she must have stepped literally over some of the chicks, yet not a single one showed itself. Presently she halted at the end of a fallen log and spoke in a new tone. Instantly the young grouse rose out of the leaves as if by magic, some from one side of the road and some from the other, and went scurrying to her. A minute later she had led the entire brood away among the sweet fern.

The children of the wilderness are letter perfect in obedience. Those who fail to obey are not likely to survive.

One other member of the grouse family upon whose hidden nest I have for years vainly hoped to spy is the spruce grouse, unwary denizen of



The ruffed grouse does not need to wait for maturity before being served well by his clan colors. The chicks blend almost as well with the forest tints as the adults. After long searching, the author rounded up seven babies and lined them up to be photographed. There are six in this picture, but the photographer himself had difficulty in picking them out.

the dense swamps of the north. The gray plumage of the hen spruce grouse serves her as faithfully in her gloomy retreat as do the brown and black, gray and buff colors of her ruffed kinsman.

In northern Michigan, where I have done the bulk of my camera hunting, this dark grouse was once abundant in the deep swamps. Much of the timber in which it dwelt has been cut off and a large part of its original range is now cleared or cutover land. For this and other reasons, the spruce grouse is on the verge of extinction south of Lake Superior.

One other factor has contributed greatly to its decline. It is poorly fitted, to an unusual degree, to survive in close contact with man.

It is one bird that seems totally unable to master the lesson of fear. In the shadowy fastness of its native swamps it meets human intruders without the slightest wariness. It will walk away from a man, over the gray sphagnum moss and through the undergrowth, not hurrying unless pursued too closely, in which case it takes refuge in the low branches of a tree, perhaps almost within reach of his arm, and peers down at him with less show of fear than his own farmyard fowls are wont to display under like circumstances.

If he stands quietly the bird soon forgets all about him. It will crane its neck this way and that, studying the surrounding swamp as if he were not there. It is likely to walk out onto the branches of the tree and begin quietly feeding on buds and needles, entirely forgetful of any peril.

It can be and has been, knocked down from its insecure perch with a stick, decapitated with a deftly wielded switch or snared in a noose. Against modern man and his firearms it has not the slightest chance of existence, save by an uncommon generosity on his part.

Most of those who know this dark grouse of the north charge it with gross stupidity for its failure to grow man-wise and shy. The name "fool hen," by which it is generally known among woodsmen, reflects this opinion. Personally I cannot accept this belief. Unwary and bold to a point of recklessness the spruce grouse undeniably is, but I do not think of this swamp gallant as a wilderness dolt.

Be that as it may, however, his ranks have been thinned, as the lumberman and trapper

and the clearing farmer have invaded his range, until today he is found in only a few of the remote wild sections of my state and even there he is dangerously near extinction, as I am told he is also in New England, northern New York and other states that once harbored him in abundance.

As a result, my ambition to find and photograph the nest of the spruce grouse has gone unrealized. The one pair I have ever seen in their native wilderness were not at their nest.

The season was mid-May. I was moving with two companions, through a dense swamp in the Two-Heart River country, on our way to a little trout stream that fed into Lake Superior. Beavers had dammed the stream where it emptied out of a small lake, flooding a large tract of swamp, and as a result we were making a wide detour, following a broken chain of dry, arbutus-blanketed hummocks that led in the general direction of the stream.

Out of a tangled thicket of leatherleaf and bog laurel, where the sphagnum made a deep soft carpet, we flushed a small grouse. Her size and coloring were not those of the ruffed grouse, and hope was suddenly born in me that at last I was at the end of a long quest.

We followed cautiously in the direction the bird had taken between the trees and within fifty yards we found her perched in a spruce tree, a dozen feet or so from the ground. Our first glimpse confirmed the belief that she was a hen spruce grouse.

She was more nervous than I had anticipated. She moved restlessly about on her perch and several times she seemed about to take wing. I approached cautiously and before I had finished with my camera, one of my party who was sitting some distance away on a dry hummock, called my attention in a low voice to something coming through the undergrowth on my left.

I moved a little farther around the spruce tree for a better look. Moving toward me through the leatherleaf thickets was a small dark grouse, white and black and gray, with small scarlet crescents above his eyes that shone like jewels in the spring sun.

His tail was spread fanwise, like that of a strutting turkey cock. His wings were held stiffly down at his sides until their tips all but brushed the moss. The feathers of his breast and throat were lifted until he looked twice his

real size. Across his ruffled breast a row of white feathers made a striking white chaplet, and back of his tail a rosette of white feathers was thrust out at a sharp angle like the plumes of a Sioux war bonnet.

As he came on he cocked his head first to one side and then to the other. He made short circles through the undergrowth but always he came on.

At frequent intervals he halted to knock a few flecks of bark from the base of a convenient tree with short, savage jabs of his bill, as if to impress us and the hen with his valor. Two or three times when no tree was at hand he made the same short thrusting movement at the empty air. And he showed no more fear of me than of the logs he stepped upon.

I moved cautiously two or three times, trying to put myself in a location where I could use the camera, but the heavy undergrowth balked my efforts each time. I had resigned myself to failure when the bird reached the end of a dry, fallen log and hopes of a picture flared up in me again.

The log afforded a natural highway for such

antics as the spruce grouse was indulging. Midway of its length it lay for the space of a few feet free of underbrush and shadow. If he would walk the length of it, if he would cross that open space!

He looked the log over carefully. Finally he hopped up onto the end of it, looked in my direction, hopped down again. Then he swung off with mincing steps, made a short circle, came back, hopped again onto the log and paraded like a proud drum major of the forest.

I had the camera on him, focused and ready, when he took the first step. I held it on him until he was free of cover, in full sunshine, midway of the log. But I must confess to a mild attack of what hunters know as buck fever. In my eagerness I failed to halt the swinging motion of the camera as I pressed the shutter release. The picture showed the strutting spruce grouse reasonably clear but the trees and other objects in the background blurred from the camera movement.

As a camera-hunting friend later taunted me: "It's too bad somebody couldn't have a chance like that who knows how to use a camera."



A log afforded a natural highway for the antics of the cock spruce grouse as he displayed before his mate. His tail was spread fanwise, his wings were held stiffly down at his sides, and the feathers of his breast and throat were lifted until he looked twice his real size. Up the log he paraded, into the sunlight—and then the photographer got "buck fever."

New Animals Again!

Three Prizes Arrive in a Single Shipment: Bamboo Rats from Siam,
Coneys and the Rooi Rhebok from Africa

CLAUDE W. LEISTER

EVERY member of the staff of a zoological park greets each new shipment of animals with the hope of finding something new or rare. In a previous number of the *Bulletin* (Vol. 39, No. 4, July-Aug., 1936) there appeared an account of an interesting shipment then newly received. Early in June of this year another consignment of animals contained several additional rare species. The three outstanding mammals received at that time included a trio of bamboo rats, two pairs of coneys or hyraxes and a nice specimen of the African antelope known as the rooi rhebok.

Receipt of the bamboo rats places this interesting rodent in our collections for the first time. In general appearance, probably because of the reddish-brown color about the head and their approximate size, our specimens call to mind a fat American muskrat. Immediately, however, one distinguishes the attenuated, rounded tail and the prominent, outward-curving incisors, deep orange in color. The eyes are very small. A more apt comparison, perhaps, would liken the animal to a monstrous field-mouse.

Apparently but little has been published concerning the life history and general habits of bamboo rats, although it seems that the several different species are generally similar in most respects. They live in burrows of their own making, utilizing teeth and claws to cut their way through the soil and any obstructing roots they should happen to encounter. The food consists mostly of roots and vegetables, including young shoots of the bamboo. They are slow-moving, apparently stupid animals, offering no particular resistance to capture except a snarling, desperate stand at the last moment, going

into action with wide open jaws. Then their large teeth command respect and caution.

Unlike the soft and durable fur of the muskrat the fur of the bamboo rat is harsh and thin. The animal is of no particular economic importance with the exception that its flesh is eaten by many of the tribesmen of the hills.

While bamboo rats are confined to the Malay Peninsula, through Siam and India to the Himalayas and China, closely allied species are found in Ethiopia. Our species is the large bamboo rat, *Rhizomys sumatrensis*, and was received from Siam.

The hyrax or coney is another animal which always adds interest to a collection. Being shy and retiring and about the size of a rabbit, it fails to possess any considerable amount of exhibition value. Outside of being received so infrequently that it is seldom seen in zoological parks, the reason for its being desirable for any collection lies chiefly in the fact that it is a zoological peculiarity, one that has furnished many a puzzle for zoologists in the past. Its general appearance completely belies its relationship to other mammals and it is therefore of special interest to students and others who have some knowledge of animal life.

Few persons realize that this little animal, living in holes and crevices among the rocks of Africa and Syria, is closely related to the elephant. It bears the distinction of being one of the wild animals mentioned in the Bible and even then its peculiarities were recognized. It is of added interest to remark that our present day knowledge of animals finds these early allusions to the coney correct only in part. Coneys are rather difficult to trap and, therefore, can truthfully be called an "exceedingly wise,"



The large bamboo rat from Siam is being shown in the Park's collection for the first time. As its name indicates, it is fond of the young shoots of bamboo—and in turn, some natives of the hills are fond of the tender flesh of the bamboo rat.

though a "feeble folk." But the much-quoted statement that he "cheweth the cud but divided not the hoof," is incorrect. Coneys have a peculiar, nervous habit of moving the lower jaw, as if they are chewing, but actually they do not chew their cud.

Coneys are generally rodent-like in habits and the food consists entirely of herbivorous materials. In habits and general appearance they possess no characteristics of particular interest. Their whole claim to fame lies in their puzzling relationship to other mammals (the elephant—horse—rhinoceros section of the *Ungulata*) which their structure indicates. Superficially, the resemblance to rodents is very striking.

Any student of mammals is impressed by the peculiar teeth of the coney. The upper incisors are unlike those of any other mammal. As in

rodents they grow from persistent pulps. They are not flattened from front to rear, however, but are prismatic in shape with one surface toward the rear. As in rodents this posterior surface lacks a covering of enamel. The teeth are therefore worn down, not to a chisel-like edge, but to a sharp point. In the live animal these long and pointed incisors are to be respected, for they can inflict an ugly wound.

A surprisingly large number of persons pause to examine our coneys, their curiosity and interest being aroused equally, perhaps, by the known peculiarities in the structure of the animal, with the resulting puzzle in

classification and because of the Biblical references noted above.

A third animal received in this shipment, a species not previously exhibited in the zoo-



Few persons realize that the little hyrax, living in holes and crevices among the rocks of Africa and Syria, is closely related to the elephant. It has another distinction, of being one of the wild animals several times mentioned in the Bible

logical park, is a handsome little mountain reedbuck—the rooi rhebok of the South African Boers. Our specimen, while not fully adult, appears to belong to the East African race known as Chanler's mountain reedbuck (*Redunca fulvorufula chanleri*).

Mountain reedbucks differ from the true reedbucks, distinctly lovers of the moist, reed-grown areas along lakes and rivers, in that they are always found in hilly or even mountainous country. When occasionally encountered in the plains regions they are confined to the slopes of deep ravines, which locality approximates mountain conditions.

Col. Theodore Roosevelt, in his "African Game Trails," writes of this antelope:

"On the steep, rocky, brush-clad hills there were little klipspringers and the mountain reedbuck or Chanler's reedbuck, a very pretty little creature. Usually we found the reedbuck does and their fawns in small parties, and the bucks by themselves; but we saw too few to enable us to tell whether this represented their

usual habits. They fed on the grass, the hill plants, and the tips of certain of the shrubs, and were true mountaineers in their love of the rocks and rough ground, to which they fled in frantic haste when alarmed. They were shy and elusive little things, but not wary in the sense that some of the larger antelopes are wary."

Many of the African antelopes look so much alike, especially members of the reedbuck and waterbuck groups, that only collectors and hunters, after a long time spent in the field, see enough of the animals to learn to differentiate them. Seldom can a zoological park exhibit more than a few of these closely-related species at the same time. A collection of antelopes, sufficiently extensive to include enough species to show their relationship, is, and always will be, merely a dream of the park director. The best we can do is to be ever on the watch for new species so that over a period of years a wide variety and a comprehensive series can be shown to the public.



Another animal new to the Zoological Park is the handsome little mountain reedbuck that is called the "rooi rhebok" by the South African Boers. Col. Theodore Roosevelt called them "shy and elusive little things, but not wary in the sense that some of the larger antelopes are wary." Our new specimen, of the East African race, is not yet fully adult.

Flight Rhythm

Cormorants Have Their Style of Flying, and Pelicans Have Theirs, But Sometimes the Cormorants "Go Pelican"

WILLIAM BEEBE

THE flight of birds is as characteristic as the walk of individual human beings. We can often recognize a friend by his mode of walking at a distance greater than we could know him from stature or features. But flight is of far deeper significance than human progression, being a trenchant character in the distinction of families and even species. To approximate this significance we would have to suppose that all Germans, men, women and children, progressed only by means of the goose-step, or all Hottentots went through life solely by hops, skips and jumps.

I have sometimes been doubted when I have identified a bird by a momentary flash of its wings as it shot past, but even the brief glimpse of migrants crossing the face of the full moon is sufficient to tell warbler or sparrow from goldfinch or woodpecker. It would be unthinkable, to our minds, for a hummingbird to soar or a duck to progress by long, dipping loops, yet on my recent trip on Mr. Crocker's yacht *Zaca* in the Gulf of California I twice observed a flight phenomenon almost as strange and fully as unexpected.

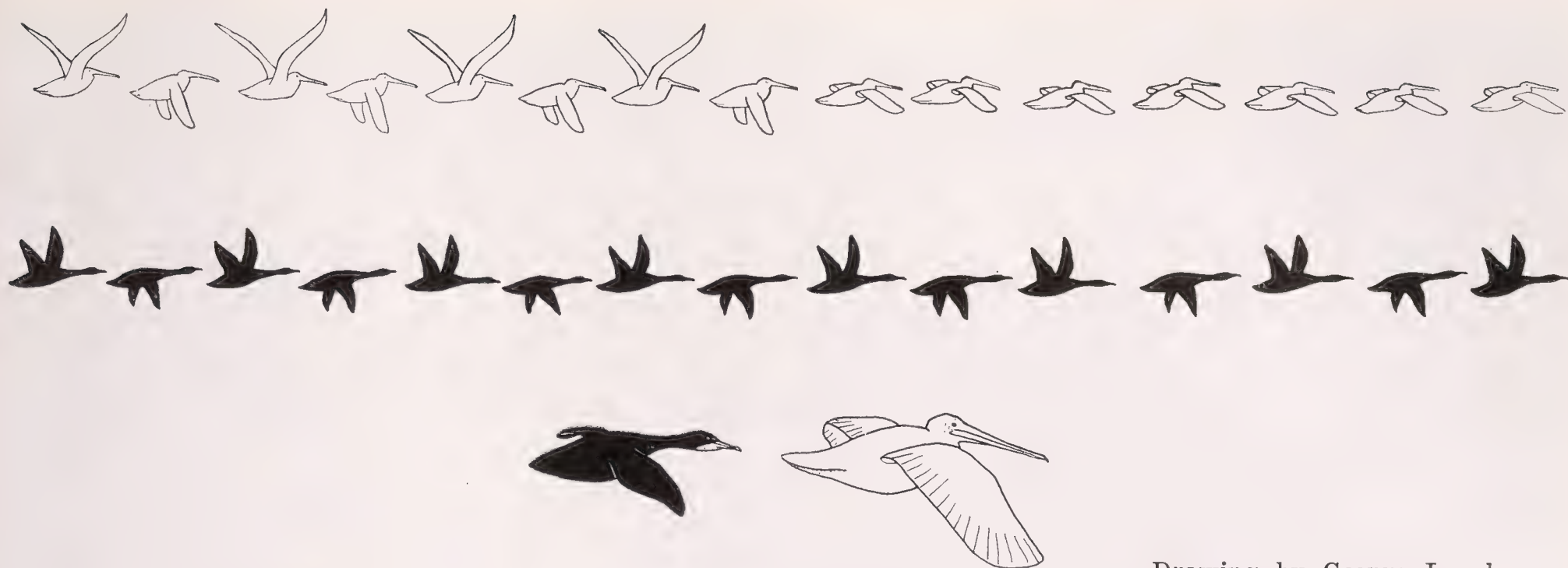
We had been at anchor for several days in Inez Bay, half way up the Gulf, where one of the commonest sights from dawn to dusk was the great number of cormorants and pelicans. There were thousands of the former and scores of the latter. The cormorants passed to and from distant fishing grounds in long straight skeins, sometimes several hundred in a single line, each close behind the bird in front until an oblique view often showed a solid, discontinuous line of dark bodies. Duck-like, their wings beat in swift constant measure, a steady unvarying vibration, with, however, no attempt at synchronization with the bird in front or behind. The wings of these birds are relatively short,

and when near at hand they gave forth a peculiar roaring whistle unlike any other sound I have ever heard.

The flight of the brown pelicans is radically different from that of the cormorants and in all parts of the world where these great ungainly birds are found their flight to its least detail is as identical as that of a bird and its shadow. Their favorite formation is in short lines, straight or oblique, consisting usually of about six to twenty individuals although fewer and more are common sights. The moment the birds leave their roosting places on rocky islets or low bushes, or, when satiated with their catch of fish they start for home, they fall into single file, and at once the leader sets a rhythm which they all follow. The only way I can indicate this in words is, flap-flap-flap-flap-gliiiiide, flap-flap-flap-flap-flap-gliiiiide. There may be five or seven or even a dozen flaps, while the length of the glide seems dependent on the amount of impetus. With a head wind there will be more flaps and a shorter glide. Before any appreciable slowing down or loss of elevation, there ensues another series of flaps. If, en route, a new bird joins the file, he instantly falls into step, or rather flap.

The imitative reaction to the leader by the others appears almost instantaneous, especially in the case of a half dozen pelicans, but in a line of twenty or thirty, a slight individual delay is apparent. This mental drag is multiplied by each bird in succession, becoming so appreciable that there may be two nodes of wing flapping down the line, just as the delay in sound-carrying of a military band may, to the eye of the observer, as he looks down the distant columns, make successive segments of a long parade seem to be out of step.

The fact of this drag in the flight of pelicans



Drawing by George Lenahan

The line of birds at the top illustrates the flight rhythm of the brown pelican as it flaps and glides. The birds in black are the cormorants, whose wings beat in swift, constant measure without gliding. But below are a cormorant and a pelican flying together in the gliding phase of the latter's rhythm, as they were observed in the Gulf of California.

shows conclusively that the tempo and change is taken by each bird in turn from the one in front and not from the leader. The position of this leader is, I believe, sheer accident, and although he must bear the brunt of the full force of any head wind, I have never seen him fall back or change places.

In addition to this regular lock-step flight, pelicans in spite of their apparent ungainliness, can set their half-closed wings and their beak in the form of an arrowhead, and dive with terrific speed and effectiveness. Still more surprisingly they can soar quite as well as vultures or eagles. I will never forget a first visit to Florida with John Burroughs, when our glasses resolved a cloud of slowly-revolving motes high in the heavens over Indian River, into several hundred brown pelicans.

But this is aside from the intention of this article. On an April day in a moment of relaxation I was looking idly from the deck of the *Zaca* out over the waters of Inez Bay. A file of a dozen pelicans passed and a distant line of cormorants, recorded automatically by some part of my mind, but not disturbing my meditation. Another small flock of birds approached and my eye wandered idly to it with the instant effect of a strong electric shock. I stood up and knocked over my chair. As at all times of extreme ocular concentration my mouth as well as both eyes was wide open. I instinctively reached for my glasses but did not lift them, for the birds were only fifty yards away. The arresting thing was, that of the six birds, three

were pelicans and three cormorants, all head to tail, close together in perfect alignment, in the order of pelican, pelican, cormorant, cormorant, pelican, cormorant.

This was strange enough, although these birds associate in most friendly fashion both in their roosting places and when fishing. But the fact which had aroused all my concentrated interest was that the cormorants had *gone pelican* in their flight. In spite of the disparity in size these six birds were all flap-flap-flap-flap-gliiiiing as if all were pelicans.

To the unornithologically minded this may seem a fact of but slight importance but to me it was fraught with significance. Throughout all the days, years, and no-one-knows-how-many centuries and millenniums these pelicans had slowly evolved their physical characters together with their specialized flight, and the latter had always seemed to me as unvarying and specific as the voicelessness or the great beak and pouch; on the other hand the swift unchanging beat of cormorants' wings appeared inseparable from the emerald eye, strong hooked beak and mobile neck. Yet here, for no apparent reason, three cormorants had enlisted in the lock-step squad of brown pelicans, and were flapping and gliding as if from the time of the fossil Nth great-grandparents of all cormorants they had never flown otherwise. It gave to think furiously and brought the flight of all birds into a renewed appraisal and interest.

This aroused watchfulness was rewarded within less than a week when several of us

were sorting a dredge haul and my observation was confirmed, this time with the renewed emphasis of simplicity in that only two birds were concerned. A single pelican came along, closely followed head to tail, by a single cormorant, and from the time when we first saw them abeam, to when they passed beyond the range of our glasses, they never ceased to keep perfect pelican rhythm, flap - flap - flap - flap - gliiiiide.

Pelicans and cormorants, together with two other diverse groups—the gannets and snake-birds—form four families of a single suborder, *Pelecani*, but their individuality in action when on the wing is almost as great as their physical disparity. The shift in flight pattern from cormorant to pelican is remarkable for several reasons; first from the specific point of view,

the relinquishing of an age-old evolved method of flight for even the temporary adoption of another, more specialized. Again the heavy, compact, anserine body and relatively short wings of the cormorants would seem ill-adapted to the long glide so close to the surface of the water. Third, the adoption even rarely of the pelicans' flight hints that there is a very real advantage in the single line formation, probably as wind break and reduction of air resistance. And while we can say with some assurance that the intermittent glide is a conservation of energy, instant response is to wonder why the pelicans alone require this economy.

In all save the most obvious things our ignorance concerning the *Whys* of the diversities in flight of birds in the air still is almost complete.

Needed: A Setting for a Great Pheasant Collection

Plans Have Been Drawn for a Modern Aviary that will Exhibit the Full Beauty of a Spectacular Group of Birds

W. REID BLAIR

"SPECTACULAR" is an overworked word, but one that can in all propriety be applied to most of the pheasant species of the world. From the ruby splendor of Temminck's Tragopan to the purple iridescence of the Impeyan, there is an astonishing range of brilliance and sheer beauty that no other large group of birds can match.

It has long seemed to us here at the Zoological Park that our large pheasant collection was receiving far less attention by our visitors than it deserved, and it seems now, when the collection is the largest and finest in the history of the Park, that the time has come to call attention to it by one necessary act: to build a Pheasant Aviary that for the first time will display these lovely birds in an appropriate setting.

Not only is a Pheasant Aviary an important unit in the program of building that I have been outlining in recent numbers of the *Bulletin*, but it has the advantage of being relatively inexpensive, as major buildings go. We estimate that a

soundly built "garden aviary," in construction equal to our other major buildings, can be erected for approximately \$40,000.

The present frame building, by courtesy called "the Pheasant Aviary," has never been and can never be made satisfactory either for exhibition or winter housing of the collection. The only purpose to which it can be put, eventually, is the housing of the overflow of commoner and more familiar species from the new Aviary which we hope to be able to build.

Our members will recall that at the south end of the Ostrich House, between the ostrich corrals and the Antelope House, is a large and open plot of ground bordered by walks and trees. In this area, so perfectly placed and so conveniently sloping to the east, south, and west, we propose to build the new home of our pheasant collection.

Over a period of years Curator Crandall has given much thought to the special features of construction that an aviary for such shy and



The site selected for a new Pheasant Aviary. The south end of the Ostrich House is at the left, and at the right is the walk leading to the Antelope House. Most of the trees surrounding the site can be incorporated in the aviary, their trunks projecting through the screen tops of the runways.

nervous birds requires. With our Engineering Department he has worked out a ground plan that is eminently practical.

The proposed Aviary is oval in form, the central feature being a low building of stone and tan brick which will house the inside shelter pens of the birds and the keeper's, feed and heating rooms. This building is 54 feet long and 22 feet in central diameter. Radiating from it are 32 corrals, each 25 feet long and tapering from 10 feet in width at the outer end to 5 feet in width at the inner end where they join the building.

Each pair of adjacent corrals are united, inside the building, in a community inside pen where the less hardy birds will be sheltered during the winter. Gates at the outer and inner ends of each separating fence will permit the keeper to pass from one corral to another with a minimum of disturbance of the occupants, and another gate in the outer end of each fifth corral will give access from the periphery.

Projecting from the walls of the central building will be open shed roofs, 6 feet high inside and extending outward 6 feet, to provide shelter for birds left outside during the winter. These open shelters have glassed sections, removable,

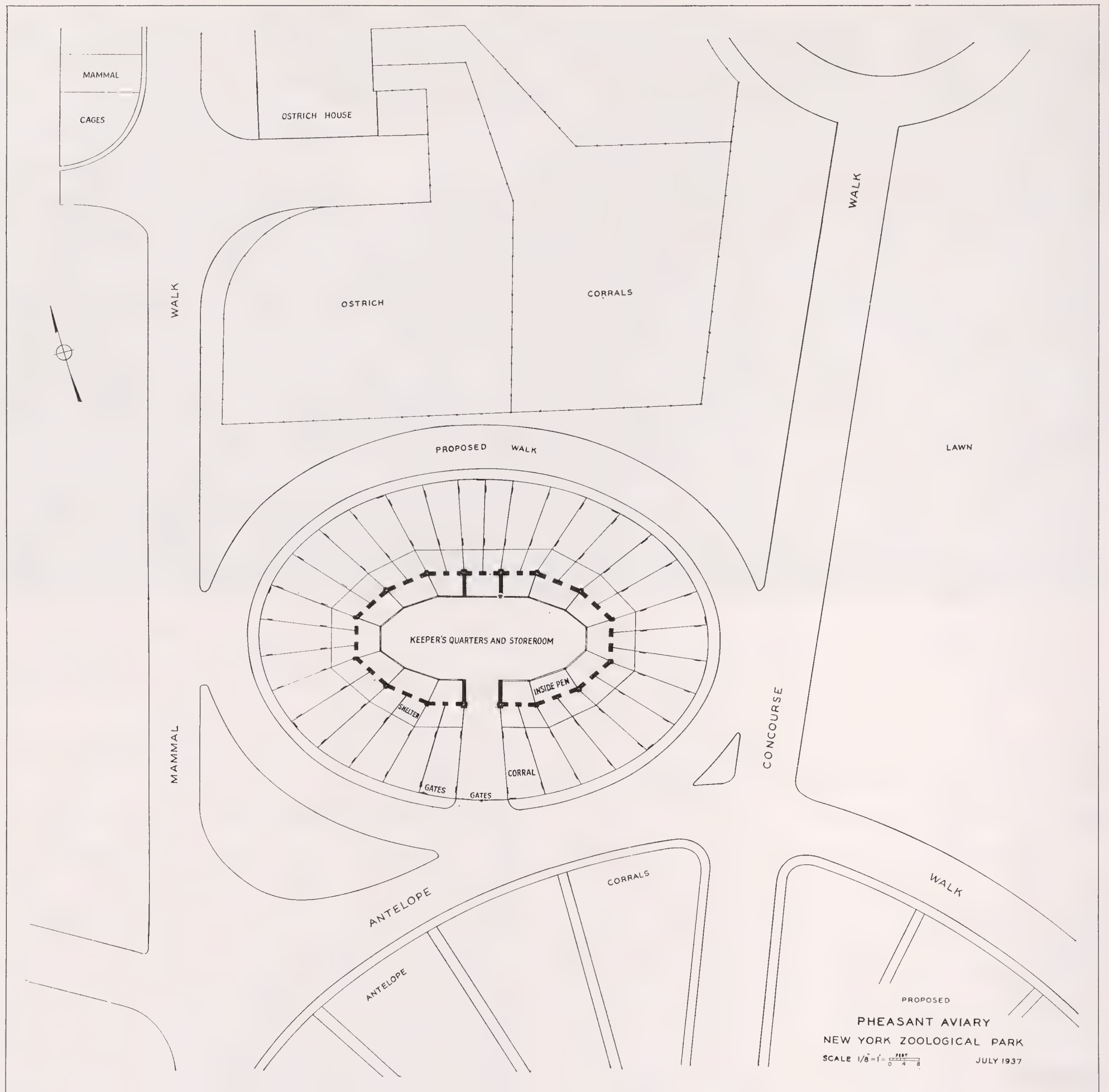
which will partly close them during severe weather.

Skylights over the inside pens will give daylight illumination and additional skylights over the large, open, central space used by the keeper and for grain storage and the heating plant may be raised for ventilation.

The inside of the building will not, of course, be open to the public and can be devoted entirely to the services of maintaining the collection.

Although the necessities of laying out a structure oval in form require some slight variation in the dimensions of the corrals, their approximate length of 25 feet and width of 10 feet at the end which visitors will pass, are proportions that permit adequate planting to bring out the fullest beauty of the pheasants. Runways of such width permit thick sodding, although a narrow border of gravel along the sides of the corrals will make a path for the birds in their habitual running around the corral. Flowering shrubs and vines, some of them of an evergreen variety, will be planted as a background for the brilliant plumage of the pheasants.

If the drainage problem can be handled successfully, Curator Crandall has suggested that each corral be provided with a small pool or



rivulet of flowing water. These will not, of course, be connected from corral to corral because of the danger of transmitting disease from one to another.

In buildings designed to house birds, rat-proofing is obviously essential and in such details as deep-sunk outside coping, small-mesh wire coverings for the corrals, and all metal and stone, or brick, construction, the specifications drawn up by Curator Crandall are most explicit. He has provided for floors and walls of the inside, or winter, pens to be of a composition substance that will be warmer than the cement pens in the present Aviary.

All in all, we feel that the amount of thought and effort that have entered into the planning of the Pheasant Aviary are a guarantee of its real practicability and its harmony with the other large buildings in the Zoological Park.

As will be seen from the ground plan of the Aviary, with the adjacent buildings, corrals and walks indicated, the proposed building fits snugly into the area selected and will, we think, cause a minimum of disturbance of the shade tree and shrubbery planting. Two or three trees near the outer edge of the grassy area can easily be incorporated in the corrals, by paying special attention to the method of fastening the wire

mesh covering of the corrals to the tree trunk to prevent rats from entering.

There are some fifty kinds of pheasants that are obtainable from breeders or the wild animal market with fair regularity, and when a new Aviary gives us facilities for exhibiting them properly we have every reason to believe that our collection will expand to that size. At pres-

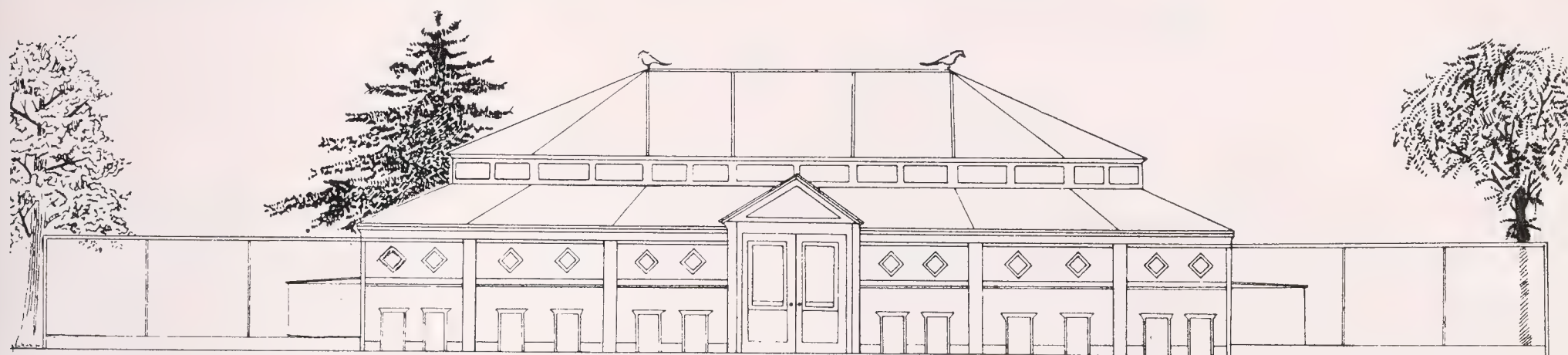
White Pheasant. *Phasianus colchicus colchicus* X *P. c. torquatus* var.

Mutant or Dark Pheasant. *Phasianus colchicus colchicus* X *P. c. torquatus* var.

Mongolian Pheasant. *Phasianus colchicus mongolicus* Brandt.

Chinese Ring-necked Pheasant. *Phasianus cochinchinus torquatus* Gmelin.

Formosan Pheasant. *Phasianus colchicus formosanus* Elliot.



An elevation of the Pheasant Aviary, showing the general architectural style but omitting the runways in the foreground. The doorway enters the central service building.

ent the pheasant group in the Park contains thirty kinds of pheasants and one allied form, the Red Jungle Fowl. Our pheasant collection contains the following, as of June 15:

Cabot Tragopan. *Tragopan caboti* (Gould).

Impeyan Pheasant. *Lophophorus impejanus* (Latham).

Brown Eared Pheasant. *Crossoptilon mantchuricum* Swinhoe.

Blue Eared Pheasant. *Crossoptilon auritum* (Pallas).

White-crested Pheasant. *Gennaues leucomelanos hamiltonii* (Gray).

Black-crested Pheasant. *Gennaues leucomelanos leucomelanos* (Latham).

Melanotus Pheasant. *Gennaues leucomelanos melanotus* (Hutton).

Black-breasted Pheasant. *Gennaues horsfieldii horsfieldii* (Gray).

Silver Pheasant. *Gennaues nycthemerus nycthemerus* (Linnaeus).

Swinhoe Pheasant. *Hierophasis swinhoii* (Gould).

Edward's Pheasant. *Hierophasis edwardsi* (Oustalet).

Bornean Crested Fireback Pheasant. *Lophura ignita ignita* (Shaw).

Siamese Fireback Pheasant. *Diardigallus diardi* Bonaparte.

Red Jungle Fowl. *Gallus gallus gallus* (Linnaeus).

Cheer Pheasant. *Catreus wallachii* (Hardwicke).

Black-necked Pheasant. *Phasianus colchicus colchicus* Linnaeus.

English Ring-necked Pheasant. *Phasianus colchicus colchicus* X *P. c. torquatus*.

Versicolor Pheasant. *Phasianus colchicus versicolor* Viellot.

Reeves Pheasant. *Syrmaticus reevesii* (Gray).

Elliot Pheasant. *Syrmaticus ellioti* (Swinhoe).

Mikado Pheasant. *Syrmaticus mikado* (Ogilvie-Grant).

Golden Pheasant. *Chrysolophus pictus* (Linnaeus).

Lady Amherst Pheasant. *Chrysolophus amherstiae* (Leadbeater).

Germain Peacock Pheasant. *Polyplectron germaini* Elliot.

Palawan Peacock Pheasant. *Polyplectron emphanus* Temminck.

Great Argus Pheasant. *Argusianus argus argus* (Linnaeus).

The present facilities of the old Pheasant Aviary are strained to the utmost to provide room for the species now on hand, and not another bird can be added to the collection until more space is available. Interest in pheasants, and especially the more exotic types that have become available in the last few years, is certainly growing, as witnessed by the formation of the Ornamental Pheasant Society of America, and we are assured that the construction of adequate quarters for our own magnificent collection would meet with the warmest kind of response from the public.

Canaries Have Come a Long Way

In Form and Color and Song the Cultivated Bird Is Far Removed from the Wild Little Native of the Canary Islands

MYRON GORDON

Zoological Laboratory, Cornell University

NINE years before the Spaniards claimed the Americas by virtue of Christopher Columbus' discoveries in 1492, the Spanish empire builders conquered and annexed the Canary Islands. The Canaries are Spanish colonies still.

To the ancient Europeans who lived before the birth of Christ, those remote islands off the northwestern coast of Africa were known only as legendary places. To the ancients they were the Fortunate Islands—The Islands of the Blessed. According to their ancient beliefs, these islands were situated somewhere on the edge of the western ocean—on the edge of the world as known in those days. These islands were regarded as the abode of favored mortals who were rescued from death by the gods. Here the fortunate lived a life of ease, "for the climate was soft and springlike and there was an abundance of all things." Yet at least one of the ancients, the elder Pliny, a hard-headed scientist, must have had a more realistic conception of these islands, for it was he who named them "*Canarias*, so called from the multitude of dogs of great size."

For more than a thousand years after their original discovery the Canary Islands were forgotten to the world. Then wandering Arabs rediscovered them in the Twelfth Century. Later, the Spaniards, at the height of their power, landed a conquering army on these unfortunate islands and practically exterminated the native Guanches. The Canary Islanders were a brave and intelligent race of men of large stature who possessed comparatively fair complexions. They had reached some degree of modern civilization, and some claim they were descendants of the ancient Goths.

A cheerful little yellow bird with a clear sweet song has made these Canary Islands fam-

ous the world over. The domesticated canary bird is a cosmopolitan creature today, but its ancestors were natives of the Canary Islands. Wild canaries are still found living in their natural habitat.

Canary birds have always dwelt in the immediate neighborhood of human habitations. Their loud clear song must have attracted the attention of the Canary Islanders of every historic period. Even now, they are caught and kept as cage birds by the present-day natives, the Spanish-blooded colonists who have replaced the aborigines. The wild canaries, although not much different in color and shape from some of their domesticated cousins, are rarely exported to other countries. Since a canary is bought chiefly for the perfection of its song, there is no demand for the native birds, as they cannot equal the songs of their educated brethren in melody, in strength, and in persistence.

Under artificial conditions imposed by man, the male canary birds are polygamous. In their natural state the birds live in pairs. In the wild, a pair of canaries will build their carefully concealed nest of mosses, dry grasses, feathers, and bits of hair in high bushy shrubs or about ten feet from the ground in trees. The wild birds are greenish and olive colored with some dark streaks above. Their foreheads, breasts, and rumps are greenish-yellow, while their abdomens are yellowish-white. The hen bird is not quite so glossy and showy as her mate. Like our own American black-winged, yellow goldfinches to which they are distantly related, the canaries of the Islands associate in flocks and, on the wing, they have the same undulating, ricocheting, wavelike flight.

The eggs of the canaries are laid in clutches of four or five. They are pale green or blue,

often spotted with reddish-brown. The climate and geography of the Canary Islands are such that they make it possible for the birds to mate and rear their young the year 'round. As the pet-loving scientist Anna Botsford Comstock says: "Canaries have not only summer and winter nests, but fall and spring nests also, and perhaps one or two extra to suit the season."

They build their first nests in February or March, in regions near the sea, for then the lower levels are warm and comfortable. In this tropical setting of date palms, sugar cane, bananas, coffee, and orange trees, the first broods of canaries get their start.

By the time the first brood can fly, the weather of the coast has become hot; the birds then seek more comfortable quarters in the foothills of the Islands' volcanic mountains. They build their second nests at an altitude of 1,300 to 2,800 feet, where the climate is still temperate. At this altitude they enjoy the same climatic advantages as are found in southern France and central Italy.

This is a region of vineyards, and the Canary Islands have vineyards that produce such world-famous wines as Canary and Madeira. The Island of Madeira is quite small and is situated not far north of the Canary Islands proper. Madeira, although under Portuguese control, geographically is rightfully regarded as one of the group of the Canaries. It, too, has its canary birds.

When the second brood of canaries is about grown, the parents again migrate upwards to higher and cooler regions. At a level of 2,800-4,000 feet, the birds build their third nest and rear their third brood in a floral region of large trees and laurel shrubbery.

In August the birds are ready for the work of preparing their fourth nest. They elevate themselves to a land of evergreens, particularly pines and junipers, a region covered with arborescent heaths. They are now at an elevation of 6,400 feet. Finally, in the region of Retana, the canaries complete their upward flight for cooler quarters. Retana is a white, flowering, and sweet scented broom found up to 11,000 feet. In this uppermost level of their earthly paradise, the birds rear their fifth brood of young in a veritable garden spot. Nine hundred kinds of flowering plants carpet the mountainside at this level. Two hundred and seventy of these

flowers are found nowhere else in the world except in the Canaries. The birds have reached their peak in living.

It is easy to see from their great industry in home making that canary birds, if left entirely to themselves, would soon overcrowd the limited area of a few islands, none of which is larger than the state of Delaware. As a blessing in wolf's clothing, the dense ranks in the wild canary bird population are constantly being thinned by the persistent efforts of native predatory hawks, falcons, and owls. Human bird-catchers take but few canaries.

For a bird that has had the paradise of the Canary Islands for its home, its contentment within the close confinement of a small cage is remarkable. Possibly this contentment, as shown by its cheerful song and will to breed in captivity, may be explained by the fact that canary birds have no inherited impulse to migrate towards the north in the spring and towards the south in the fall. When the breeding urge is strong within them in the spring, they do not go onwards and upwards. They just go upwards—and upwards only if the lower levels get too warm for their comfort.

The dietary demands of canaries, in and out of cages, are quite simple. The native canary seed is their dietary mainstay, although they require, as does any animal, a variety of foods, fresh green food as well as dry seeds.

Canary seed, like the canary bird, is indigenous to the Canary Islands. The seed is the product of an annual grass, *Phalaris canariensis*. It attains a height of two to three feet. The seeds are gathered from the egg-shaped, spike-like panicles or flower clusters which are about one to two inches long. On the Canary Islands, flour made from the seed is used in making bread. The seed is imported and used in industrial communities, as a glue for sizing fine cottons and finishing silk goods. It gives a glazed appearance to these materials. Canary seed plants are now grown in Morocco and in restricted districts of Europe and America. The cage birds of the world are assured of a bounteous supply of their favorite food.

"You have a bird-like appetite" is said frequently when a person eats but little. Yet birds are gluttonous. They are always eating because they are always hungry. They are always hungry because their bodily functions are geared

at a much higher level than that of other animals, including man. If Richard Junior, the family offspring and pride, is ill and feverish and the clinical thermometer indicates a temperature of 104°F . there is no question that something pretty serious is wrong with him. Yet Dicky, the family canary, is comfortable and perfectly normal when its body temperature is 107°F . This means that Dicky, the canary, leads a fast life—even though he spends it within the confines of his two-by-two cage. The high rate of metabolism makes it impossible for birds to survive even short periods of fasting or thirst.

Old records, chronicles, tales of travel, and volumes on natural history were searched for the true story of the coming of the canary to Europe. The experts accept Oliva's, the Roman naturalist's, story. Oliva, in 1622, told how, in the middle of the Sixteenth Century, a Spanish ship, outward bound from the Canary Islands and headed for Leghorn, was wrecked near the Isle of Elba. Before the ship was abandoned, the sailors mercifully released their captive canary birds. The canaries flew to Elba. Fortunately, both male and female canaries reached the island safely. This island, now famous in history as the site of Napoleon's imprisonment, is situated near the knee of the geographical boot of Italy. The canary birds apparently found conditions to their liking in Elba. They multiplied rapidly. They established a peculiar race of canaries on the island, a race that was more yellowish than their parental stock on the Canary Islands. Whether this was due to the influence of the new climate and new food upon the developing feathers, or to inherited characteristics peculiar to the birds that founded the canary colony on Elba, is not known.

The spry, cheerful canary bird soon attracted the attention of the natives of Elba. The Italians began trapping the wild Elba canaries for sale on the Italian mainland, in the Tyrol, and in Germany. So greedy were the Elba canary trappers for immediate profits that they caught more birds than the wild birds on the island could restore. They finally completely exhausted their profitable feathery gold mine. By the time Napoleon arrived on Elba, all the wild naturalized canaries of the islands were gone.

Once the canary arrived in pet-loving Germany, its future culture was assured. From Germany a small number of canaries was shipped to England. The traffic in domesticated, trained, hand-reared canaries gained tremendous impetus during the Seventeenth Century when the nobility of Europe adopted these birds as a mark of distinction and as a part of their costume. It was the custom for a lady to receive her visitors with a canary perched upon her dainty index finger. Birds and their ladies are so portrayed in the paintings of that day.

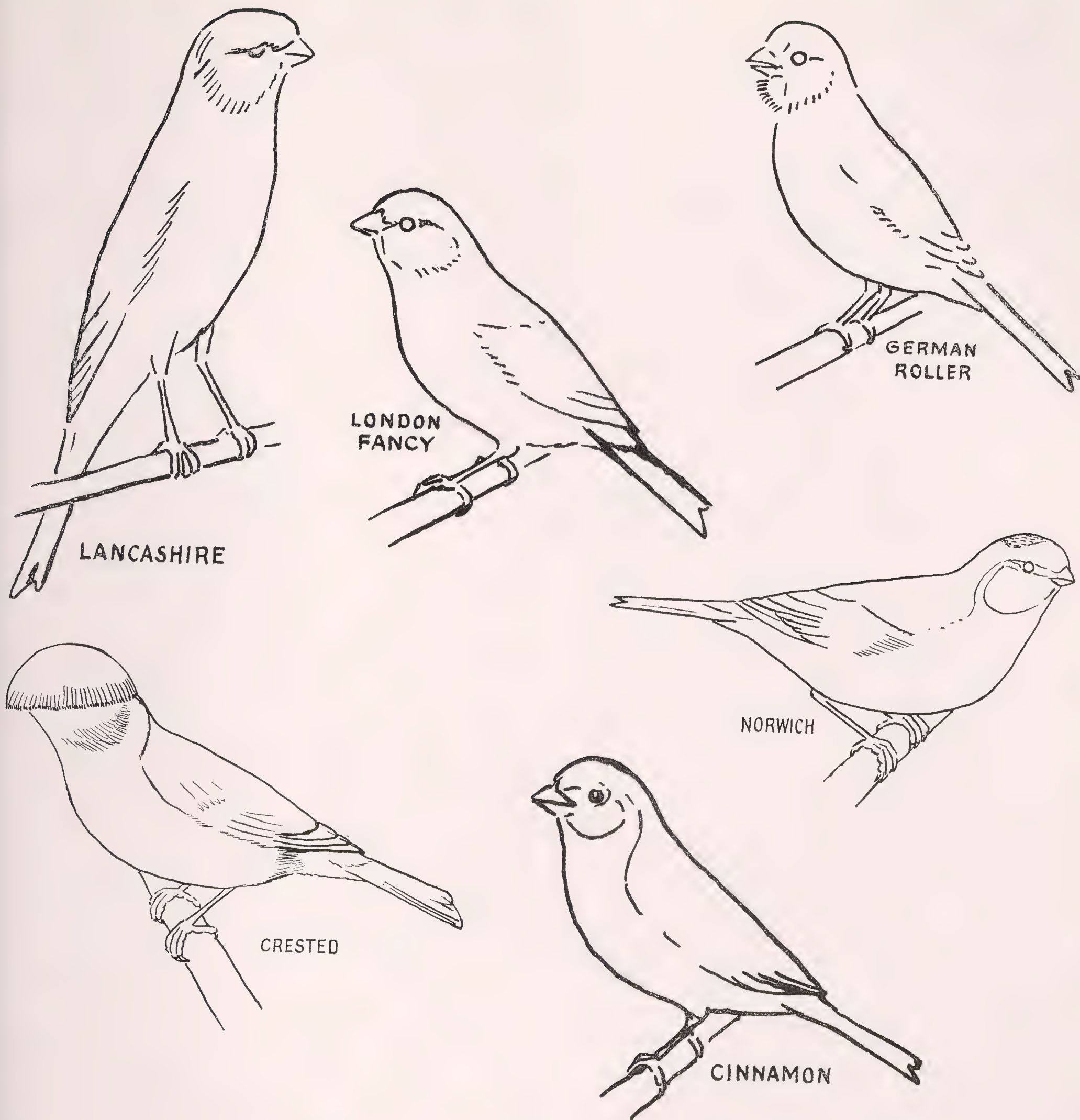
Perfectly trained and sweetly singing canaries were difficult to obtain for a long time. They were highly prized and highly priced. Today, the canary is a common household pet.

The Germans found the Harz Mountain district particularly suited to the art of canary breeding. The mountains are located in east-central Germany and the headwaters of the rivers Weser and Elbe flow from their summits. A natural plateau, elevated 2,000 feet above the sea, is found in this rugged, forest-clad mountain region. The country is dominated by the peak of Brocken, about whose summit heavy mists swirl constantly. This is the land that has inspired the weird legendary tales of pagan Teutonic literature, and the scene of Goethe's "Faust." The Harz Mountain area is also the region of great mineral wealth. In St. Andreasburg, in which city the most perfectly trained, the finest singing canaries in the world are bred, there is also one of the deepest mining shafts in Europe. The Samson shaft goes down 2,700 feet, 720 feet below sea level.

The mountain peaks of the Harz are raw and damp even in summer, but the plateaus are cool because of them. The district is a favorite summer resort because of its coolness, its rugged scenery, its forests, and its legendary associations. The canaries enjoy the region because of its equalized temperate climate.

The Harz mountaineers concentrate their efforts in canary culture on the perfection of the bird's song. They have gone a long way in changing the hard, loud, monotonous cry of the wild bird to a song of grace, melody, and variety. The St. Andreasburg canary is a trained trouper.

While the Germans have developed the canary's song to a high degree of perfection, other Europeans have devoted their time to the bird's

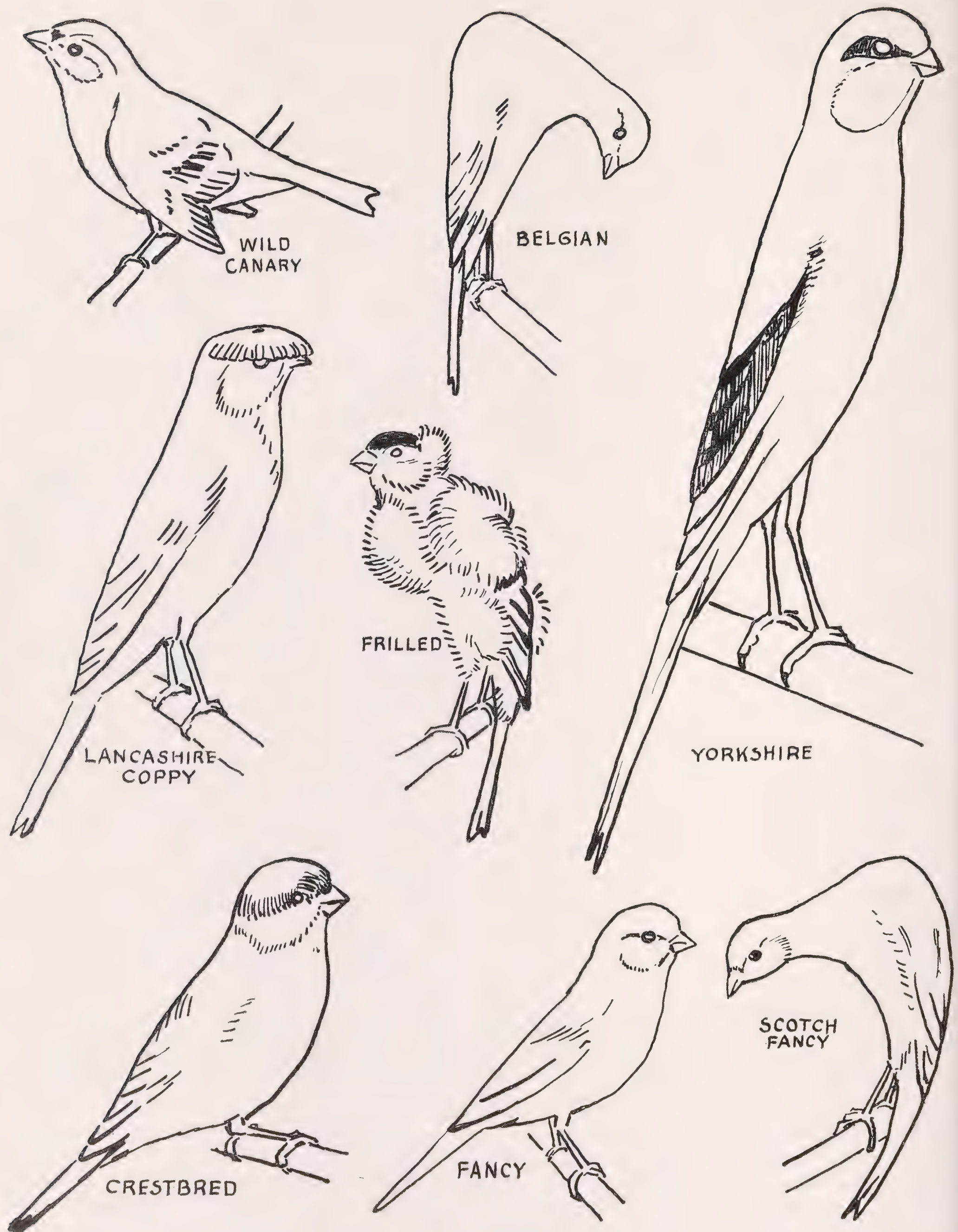


Canary fanciers of several European countries have devoted their time to a modification of the appearance of the wild canary, and have produced many grotesque variations that certainly would not be recognized by the natives of the Canary Islands whence came the original stock. These are a few of the forms developed by long and selective breeding.

appearance. Many grotesque canaries have appeared. They certainly would not be recognized back home in the Canary Islands.

The English breeders of canaries prefer variety in body and color styles. In Norwich, they prefer a short stout canary; in Yorkshire, they prefer a long slim bird with an erect carriage; in Lancashire, they desire a bird of great

length and bulk. Some of the Lancashire canaries reach a length of eight inches. Dr. W. T. Greene, the British canary expert, calls these creatures "noble" in bearing. The Scotch have peculiar taste in canaries. They demand a long thin bird that tries to curl its tail, and to a certain degree succeeds in curling its tail beneath its body in an attitude characteristic of



These are some of the more fantastic forms of fancy-bred canaries, all of them far removed in appearance from the simple and generally unattractive wild canary shown at the upper left.

a frightened puppy. As a matter of fact, this Scottish breed is easily upset. The young of the Scottish race cannot be entrusted to their parents, but are raised by foster parents of a less skittish breed.

The Belgians have gone the Scots one better in developing a freakish type of bird. Theirs is a bird with a neck so long that it droops pathetically. Its chief claim to fame is that this mournful characteristic is transmitted from one generation to another, with the consequence that a recognized breed has been established. These Belgian canaries are high-strung delicate birds—the true hunchbacks of the canary birds.

As might be predicted, the French canary breeders have gone in for frills. The French canary's feathers turn back at their tips. The breast and belly feathers and feathers of the bird's sides resemble miniature pinwheels. To the French, the bird's fluffiness appears elegant. These birds have other champions, for the Dutch also admire and breed them.

In America there are advocates of all body, feather, size and posture styles. But the most popular type of canary is yellow in color, is capable of singing a clear melodious tune, and in body is much like the wild canary.

What the canary breeder artist will produce in striving for new types of canaries, no one, including the artist, can predict. But the artist knows what he is after and he keeps breeding canaries until, by the laws of chance, he gets a bird that meets his ideal. He is unwilling to divulge his breeding technique, if, indeed, he can remember it—and he usually cannot. Consequently the origin of most of the present-day varieties, races and breeds, is lost—or rather the knowledge has never been recorded.

The scientific breeder, the student of the laws of inheritance, starts from scratch. He learns all he can from the artist-breeders and then proceeds to check their statements. If the results agree with the artist's prediction, he accepts the statements as true, bestows credit upon the one who first made the discovery, and publishes his own results. The facts become known to all.

One of America's greatest living scientific men devoted years to the study of inheritance in canary birds. Canaries were chosen for study because they were regarded as captive organisms, not too far removed from their wild pro-

genitors. The Mendelian Laws of Inheritance were rediscovered in the early years of this century. Dr. Charles Benedict Davenport wanted to test these laws on recently captivated species in order to check whether these laws applied to wild species as well as they did to fully domesticated ones. Dr. Davenport made a long list of discoveries during his years of breeding thousands of canary birds. His interests now are devoted to the study of inherited human characteristics. The recently retired head of the Department of Genetics of the Carnegie Institute of Washington with laboratories at Cold Spring Harbor on Long Island is studying the differences in heredity of short men and tall men, dark and light men, black, brown, red, and white men, geniuses and imbeciles, ship builders, admirals and musicians, presidents and paupers. And he studies their offspring.

Dr. Davenport found in his study, "Inheritance in Canaries," published in 1908, that the imperfect crested bird is dominant over the plain headed bird. The perfect crest is dominant over baldness. This means that perfectly crested birds when mated may not necessarily produce some bald-headed birds. Hereditary baldness cannot be cured by patent medicines—nor by any treatment; neither is hereditary baldness in men curable. Mottling in canaries is an unfixable character. Two mottled birds when mated will throw mottled, yellow, and self-colored birds. Yellow birds with ticking of black are dominant over pure yellow birds. Pure yellow birds when mated produce nothing but yellow birds. Cinnamon is recessive to green; cap and lacing are dominant over plain birds. Another scientist is beginning a series of inheritance experiments with canaries as his subjects. Perhaps Samuel F. Goodsell of Colorado Springs will add to our knowledge of canary bird inheritance.

Ornithologists call the canary *Serinus canarius*, an appropriate name. *Serin* is an old English name for a finch. In the early days of training canaries and other cage birds for song, use was made of a hand organ called a *serinette*. The canaries, siskins, citrils, linnets, buntings, cardinals, serins, finches and sparrows belong to the bird family Fringillidae. The canary will hybridize easily with our American goldfinch and with twenty-four other species within its

own family. These hybrids are invariably sterile.

Canaries are a definite part of our civilization. During the war they played an important part in warning their less sensitive masters of the oncoming of poisonous gases. They took no belligerent part in man's cruel battles; they were always on the side of mercy. In war and in peace they are our benefactors. In peace they are patients in our hospitals and laboratories where medical men study the dreaded disease of malaria in canaries with the hope of applying the knowledge gained for the benefit of mankind. Canaries continue their work as poisonous gas detectors in deep mines threatened with unexpected gas seepages.

But canaries' happiest duties are to enliven the common household. Champion canaries appear before the microphone. The radio has broadcasted their whistles, warbles, rolling trills,



Courtesy Standard Accident Insurance Co.

Canaries play a definite part in our civilization, in wartime as detectors of poison gas, in peacetime in hospitals and laboratories, and in mines where they are used to detect gas seepage.

their imitations of bells, flutes and the sound of bubbling waters. In America all outstanding troupers find their way to the echoes and shadows of Hollywood's cinema record. They win fame and fortune—for their owners.

That "Bird House Cat"

Distinguished by her deeds, requiring no formal name to set her apart, she is always "The Cat" to the keepers in the Bird House. Other cats there are—the Alley Cat that ranges the alleyway behind the macaw cages, and the Cellar Cats that do their mousing exclusively in the basement. But *the* cat is the cat in the quarantine room.

When Forbush was State Ornithologist of Massachusetts he broadcast a questionnaire to determine if any cat had ever been known that would not kill birds. Almost alone in the nationwide survey stood the four cats in the Bird House of the New York Zoological Park. Not only will they not kill birds, but The Cat displays actual embarrassment in the presence of any live, edible, small bird that may be at liberty in the quarantine room.

It is all a matter of training. When she was a kitten, imported as a mouser, she was taught

carefully to distinguish between legitimate prey—mice and rats—and forbidden fruit: birds of any kind or condition. The training was simple. While one keeper held the kitten, another held a small bird and with its sharp beak pecked a few times at the kitten's nose. The lesson was direct and to the point, and as a kitten and later as a cat, The Cat has never forgotten it. To The Cat, the most helpless bird is something to be feared and avoided.

In the course of the years she has borne 54 kittens, most of which have passed some time in the Bird House before going on to homes elsewhere. By some mystery of communication she has taught her kittens the lesson that she learned in infancy, and they also respected the birds in their charge. Whether they, too, in the outside world, taught *their* kittens the inviolability of birds is an interesting speculation, but of doubtful conclusion.—B.

BULLETIN

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NOTES FROM THE ZOOLOGICAL PARK AND THE AQUARIUM

Rare Monkey at the Park

New to the primate collection at the Zoological Park is Hamlyn's Monkey, from West Africa. *Cercopithecus hamlyni* Pocock is, for that matter, comparatively new to exhibition anywhere, as there are available records of only three having been exhibited in Europe, and the animal was only described as a new species in 1907 when a specimen was received at the London Zoological Garden. The new arrival here is the first to come to the United States.

In coloration, size and general markings it is undistinguished except for a startling white streak down the center of its nose. The specimen is still in quarantine in the Hospital, but will be put on exhibition shortly.

Along with it, in quarantine, is a fine specimen of DeBrazza's monkey, which has been exhibited in the Park a few times in the past. It, also, is from West Africa.

The "Snake Leather" Snake

To thousands of persons who never heard the name, the karung, or Indo-Malayan water snake, is familiar through the medium of its skin, which happens to be almost ideally suited to the manufacture of articles in snakeleather. Shoes, vanity cases, cigarette lighters and innumerable other small objects have been covered with karung skin in recent years since the vogue for reptile leathers came into existence.

Now, for the first time in some years, a living specimen of the karung is on exhibition in the Reptile House. It is a comparatively young snake,

about a yard long, but it displays the regular markings and rough skin that has made it so popular commercially—so popular, in fact, that the snake is in danger of extermination. It is reported that 400,000 karung skins enter New York in a year, to be made up into snake leather.

The karung is a confirmed water snake and can spend hours under water. Indeed, no basking surface above water has been provided for it in its tank in the Reptile House, and it shows no need for one. The snake feeds exclusively on fish.

Armadillo-proof at Last

For its size, few animals require as much thought to prevent escape as the giant armadillo of South America. For all its apparent clumsiness, the animal is an agile climber and until recently it seemed impossible to devise a cage that it could not scale. Even when the sides of the cage in the Kangaroo House were cased in sheet iron, the animal still found ways of climbing to the top where a wire netting halted it.

The netting over the top effectively prevented escape from the cage, but left an element of danger to the animal itself, which sometimes slipped and fell to the floor with a resounding thump while seeking a way out at the top. Now the screen at the front of the cage, which was used as a ladder, has been replaced by wide-set iron bars which offer no hold for the animal's great digging and climbing claws. Since the bars were set in place, the giant has been earth-bound, and apparently quite contented to be so. The floor of its cage has been covered with two feet of hard-packed dirt to give the animal a chance to indulge its liking for digging. Each morning Keeper Cully finds great holes excavated in the soil—but the giant armadillo safe in its cage.

Animals for Sale

Several groups of animals in the Zoological Park have increased to such numbers that thinning of the herds has become necessary, and prime specimens are being offered for sale. Pairs or single specimens of the tahrs, aoudads, and red, axis, fallow, Barasingha and Dybowski deer have been offered to other zoological institutions and dealers, and several have been sold, some going as far away as Colorado.

Lion Cubs at the Park

Three cubs were born to a young and comparatively new lioness at the Zoological Park on Sunday, July 11, and two have survived the rigors of early maternal care. The third cub was accidentally killed by its mother while she was carrying it around the cage. She picked the cub up by engulfing its whole head in her mouth, and in a moment of excitement, bit too hard.

For the first five or six weeks of their lives the cubs and their mother will be protected from all excitement. The lioness and her family occupy one of the cages near the north end of the Lion House, and that whole end has been blocked off to visitors. Only one keeper penetrates the barricaded area, and all stir and excitement is thus screened out.

Wildfowl Pond Visitor

A pied-bill grebe, also known as a helldiver, settled on the Wildfowl Pond about the middle of July and has either adopted it as a temporary home or is unable to get off because of the low condition of the water. Because of its peculiar anatomy, the grebe requires a comparatively long runway of open water for its takeoff and the Wildfowl Pond during the summer is at low water level. Trees that hem in the pond might make it difficult for the bird to get away if it managed to get in the air, since its rising powers are weak.

The pond is well stocked with goldfish, and the grebe does not lack for food during its voluntary, or enforced, visit.

Mosquito Exhibit

In its efforts to acquaint the public with the life history of the mosquito, the Mosquito Extinction Division of the Department of Health has again established a demonstration tank at the Aquarium. The exhibit is simple, being a collection of mosquito larvae living in water and hatching out into a sealed container, but it is clearly labeled and has excited a good deal of comment from visitors.—T. H.

"Living Fossil" Boarders

The reed fish, *Calamichthys calabaricus*, sometimes called a "living fossil" because of its relationship to the early forms of fish life, is an Aquarium exhibit upon which students of ichthyology frequently turn a speculative eye. Several

specimens, approximately twelve inches long, were "boarded" at the Aquarium for a time this summer while on their way from Professor Julian Huxley of the London Zoological Society to Dr. Thomas Barbour, director of the Museum of Comparative Zoology at Cambridge, Massachusetts. Dr. Barbour will use them in research. The Aquarium had already sent several of these interesting fish to Dr. Barbour from its own stock, and replacements are to be made by Professor Huxley.—C. W. C.

Pseudo-albinism in a Lobster

In a recent *Bulletin* article a series of color variations found in the American lobster, *Homarus americanus*, was reported. These included such colors as red, blue, cream and combination of these to form spotted patterns.

Recently the Aquarium received a lobster that was almost pure white in color. Such a color variety was not included by Herrick (1909) in his memorable monograph on the natural history of the American lobster. However the white lobster reported here is not an albino, for the eyes still possessed the normal pigmentation. A similar case of pseudo-albinism was described by Dr. R. C. Osburn for the fresh-water crayfish, *Cambarus limosus*, in a 1912 *Bulletin*.

True albinism is very rare among the invertebrates generally. Except for two species of snails (*Planorbis corneus* and *Planorbis* sp.), it is limited entirely to the Arthropods, having been reported for many of the moths and butterflies and five species of Isopods (small crustaceans).—R. F. N. & J. A.



No Demoiselle Crane chick resulted from this lone egg deposited on a barren rock on the margin of the Wildfowl Pond, for the anxious parents smashed it or rolled it into the water within a couple of days after it was laid. These lovely cranes have several times laid eggs in the Park, but have never managed to hatch one.

New at the Aquarium

Three small matamata ter-rapins have been received from the State of Amazonas, Brazil. These do not exceed four inches in length on the carapace.

From the same general region came a number of Surinam toads, *Pipa americana*, which do not seem to be particularly well adapted to life in the Aquarium. A number of infant *Pipa*, no larger than a twenty-five-cent piece, have made themselves at home much more easily than their elders.

Two giant salamanders were imported directly from Japan and were added to the tank already containing one such animal brought up from South Africa, where it has been introduced.—C. W. C.

The Aquarium collecting boat, *Seahorse*, has resumed summer operations and while no important fishes have been taken, a number of horse-shoe crabs were collected and two shipments were made, one to the London Aquarium and one to Leipzig, in exchange for specimens.—C. W. C.

An eight-foot Borneo gaviol, *Tomistoma schlegeli*, was boarded at the Aquarium for three weeks during July while it recuperated from a two months' sea voyage from Sumatra to New York. After easing its limbs and straightening out the animal was shipped to its final destination in the St. Louis Zoological Garden.—C. W. C.

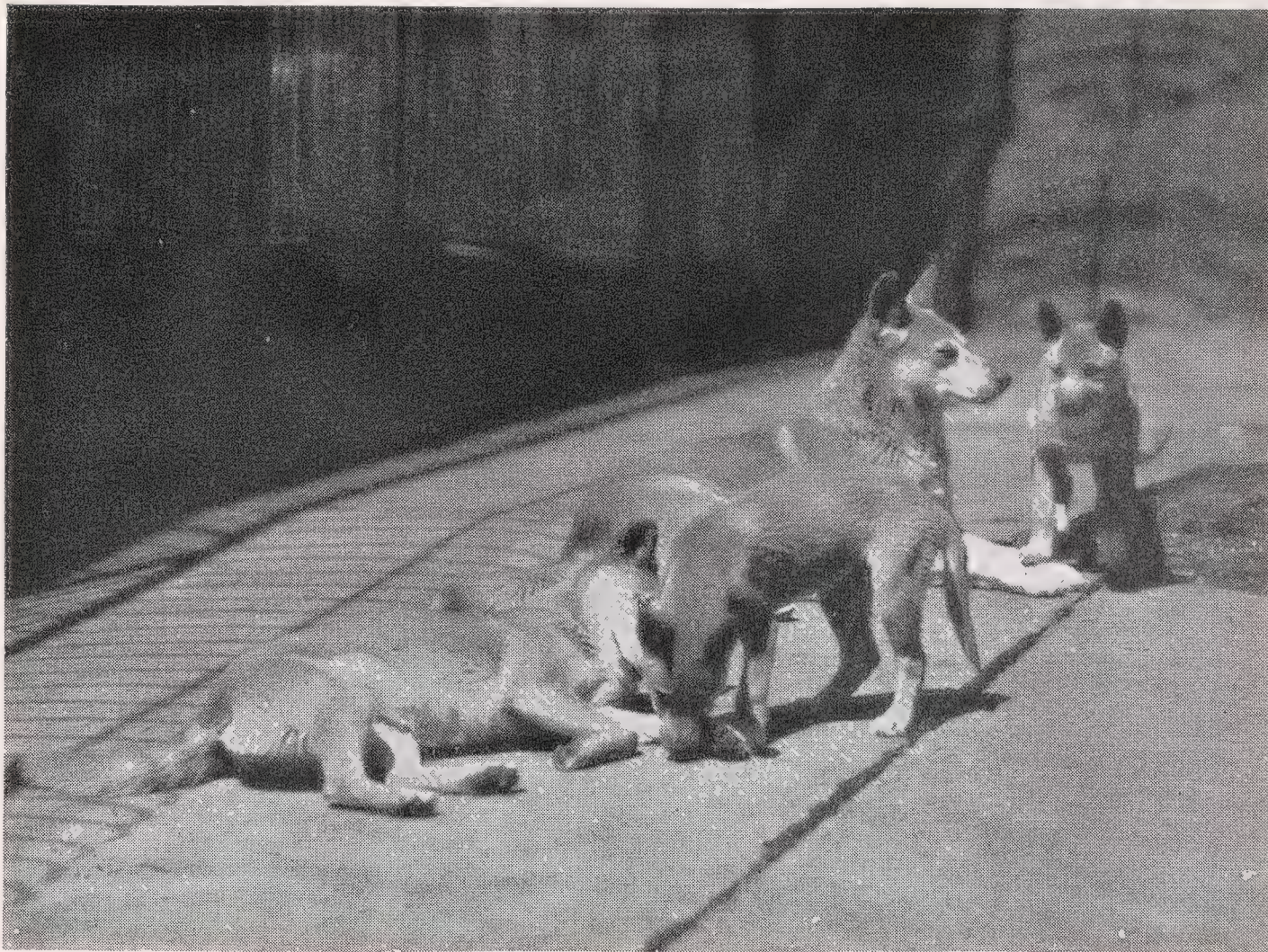
The Aquarium is well on the way toward an attendance record this year. July 4 brought a crowd of 40,982 persons, and the following day was almost as heavy, with 38,076 visitors.

PUBLICATIONS OF INTEREST

BUGS, BIRDS AND BLIZZARDS IN THE YELLOWSTONE. By Harlow B. Mills. Collegiate Press, Inc., Ames, Iowa, 1937. 76 pages, illustrated, 50 cents.

In parts of this small book there is a slight flavor of impatience with the tourists who "rush into the Yellowstone, see a moose in Willow Park, race on to Old Faithful Geyser and with watch in hand and one foot on the running board fret until it erupts." The author is a former Park Naturalist, now Assistant State Entomologist of Montana, and he has had the imagination and the opportunities to see and experience splendors that vacation-tuned visitors generally miss.

Dr. Mills' gentle gibes at tourists who are "satisfied with Old Faithful and a mangy bear" are a little unfair, for many of the events he chronicles occurred during the winter months when visitors cannot penetrate the Park. Nor can



Dingo puppies are almost as frolicsome as the puppies of domestic dogs. This little family is one of several that have been born in the Zoological Park, and successfully reared. The Dingo now exhibited in the Small Mammal House was born here.

all tourists experience a glow of enthusiasm at discovering a new species of "snow flea," as Dr. Mills does.

His booklet is by no means a nature guide to the Yellowstone, but simply a celebration in pleasantly descriptive prose of some of the experiences of an observant man who lived in the Yellowstone through the whole round of the seasons—something of the natural history of snow fleas, hiking in the Park and the close sight it affords of the wilder inmates at home, taking a census of the bighorns, reducing the Slough Creek wapiti herd, the joys and miseries of traveling on skis.

"Bugs, Birds and Blizzards" is a booklet that can be recommended to prospective visitors to the great Yellowstone region as an incitement to a closer and more thoughtful observation.—B.

MY JUNGLE TRAILS. By A. Hyatt Verrill. L. C. Page & Co., Inc., Boston, 1937. 330 pages, 32 illustrations, \$3.50.

Readers of the *Bulletin* may recall an article about the Haitian solenodon, in the January-February, 1936, issue, in which Dr. Verrill's successful search in 1906 for living specimens of the *Solenodon paradoxus* was described. That was one of many experiences in almost fifty years of tropical collecting and exploring, and some of the other highlights are the subject of this latest book. The jacket proclaims it as a book to "debunk" the American jungles as they appear in so many books in recent years, but that does not mean that Dr. Verrill's own experiences were drab and unexciting. Indeed, some writers might be inclined to envy Dr. Verrill the tales he tells while "debunking" the jungles. He says he found the ancient cannon that once guarded the road to "the richest mine in all the New World; the long lost, long sought, almost mythical Tsingal;"



This Black-neck Swan is a "problem bird." It terrorized a family of mallards, and threatened this inoffensive European Flamingo. Now it has a paddock of its own.

he observed the witchcraft of Obeah at work, helped to bring law and order to a jungle village, had a convicted murderer as a gun bearer, was made a medicine chief of the Guaymi Indians and a blood-brother of a Guiana Carib chief, discovered Indians who spoke Elizabethan English, and encountered a jungle-mad ex-reporter of the *New York Herald* who had been in Africa with Stanley.—B.

SNAKES ALIVE AND HOW THEY LIVE. By Clifford H. Pope. Viking Press, New York, 1937. 238 pages, illustrated by photographs and line drawings, \$2.50.

There has long been a need for a book of this kind and it is a real satisfaction to find that it has been done so excellently. Here, in one volume no larger than a summer novel, is all the information about snakes that the layman will want. It answers all the questions he is likely to think of, and a careful reading will go a long way toward making him a practical, if not a scientific, herpetologist.

The author's boyhood enthusiasm for snakes began to be formed along scientific lines when he spent a summer as an assistant in the Reptile House in the Zoological Park. Subsequently, he spent two summers at the Society's tropical research station at Kartabo, British Guiana, and then followed four years in China with the Third

Asiatic Expedition of The American Museum of Natural History. Out of the latter experience came a great monograph on "The Reptiles of China."

With such a background it is apparent why "Snakes Alive" is such a thorough and comprehensive book. Technical language and "heavy" language are flaws that might be expected, but they have been adroitly avoided, and the layman will find the text easy to read and understand. Chapters deal with the usefulness of snakes, their size, age and growth, senses and intelligence, feeding, reproduction, locomotion, defense, enemies, where they live, hibernation, popular beliefs, snakes as medicine, snake hunting, snakes as pets, venoms, snake bite and its treatment, the technical classification of snakes, and, as an appendix, a key for the identification of the snakes of the United States. The latter is illustrated by line drawings indicating the scale characters that play a part in identification.

With "Snakes Alive" on the shelf beside Dr. Ditmars' "Reptiles of North America," the layman will have a herpetological library that is sufficient for all but purely technical investigations.—B.

Reprints of "The Value of Predatory Mammals," by Dr. W. J. Hamilton, Jr., published in the March-April *Bulletin*, have been requested by the National Park Service for distribution to superintendents and other officers of the Service in charge of western national parks and monuments, and have been supplied by the Department of Publication. Dr. Hamilton's article presented incontrovertible proof, based on analyses of stomach contents, that the coyote, fox, skunk and weasel are economically valuable animals.

"CLEVELAND'S NATURE TRAILS"

An interesting contribution to nature education will be found in "Cleveland's Nature Trails," from the Public Service Bureau of the *Cleveland Press*. This series of nature sketches is edited by Omar Ranney and the text is by Dr. Arthur B. Williams, Ecologist of the Cleveland Museum of Natural History.

"Cleveland Nature Trails" is intended as a guide to the woodland reservations belonging to the city park system and found within the metropolitan area. As issued, the booklet consists of twenty-six pages of informative material concerning the plants and animals to be found in the vicinity, illustrated with diagrams, photographic reproductions and drawings, some in color. Inasmuch as the booklet is a loose-leaf affair and can be added to from time to time it will become increasingly valuable to nature students. The price is only ten cents, postpaid.

Apparently, this is a unique contribution by a newspaper to its readers and lovers of nature in general. The writer can not recall any similar or comparable work done by our New York papers. None of them runs a column of general interest to the nature trailer, in spite of the fact that New York City is superbly located with a wealth of material close at hand. That the public appreciates such service can be deduced from the fact that 7,500 copies of "Cleveland's Nature Trails" were sold in a week's time.—C. W. L.

Serpents of the Northeastern States

By RAYMOND L. DITMARS

HERE is a comprehensive, yet compact, book about the snakes of the northeastern states that will prove to be extremely useful to everyone with a summer home or camp in that region. This guide to the venomous and non-venomous reptiles of the New England area, New York, New Jersey and eastern Pennsylvania, is a practical and handy reference work. It gives a key for ready identification of snakes, descriptions of their feeding and breeding habits, notes on distribution and photographs of every species found in the northeastern states, including color plates of the copperhead and rattlesnake. One section is devoted to the emergency treatment of snakebite.

"Serpents of the Northeastern States" was originally published as a complete number of the BULLETIN and several reprintings were quickly exhausted. It has been republished in a new format, somewhat revised as to text and nomenclature, and four photographs have been added.

60 pages, 41 illustrations.

50 cents postpaid.

Department of Publication & Photography
NEW YORK ZOOLOGICAL PARK
185th Street & Southern Boulevard
New York, N. Y.

PUBLICATIONS

Free to Members:

Bulletin: The official publication of the New York Zoological Society reports bi-monthly on interesting phases of work at the Park and the Aquarium and contains articles on natural history in a sound yet popular form, with many illustrations. Thirty-eight volumes have been completed.

Zoologica: Scientific contributions of the New York Zoological Society. Volumes I-XIX and Volume XXI are complete, and Volume XX is in preparation. Volume XXII will be issued during 1937, in quarterly parts. *Zoologica* is sent to Members on request.

[*Zoopathologica*, Scientific contributions of the New York Zoological Society on the diseases of animals, has been discontinued and future papers on animal pathology will appear in *Zoologica*. *Zoopathologica* is complete in Volumes I and II, which are indexed.]

Annual Report: Documents, reports and pictures of the work of the various departments of the Park and the Aquarium. As a rule it contains articles of scientific value and considerable general interest.

Gallery of Wild Animal Paintings in the Zoological Park: A handsomely illustrated catalogue of the gallery in the Administration Building at the Park, which Members may receive on request.

A classified list of the publications of the Society, with subject headings of articles printed in the *Report*, *Zoologica* and *Zoopathologica*, as well as reprints from them, will be furnished on request. Some of the publications have become exhausted and orders for any issues will be governed by this circumstance. Orders for any of the publications should be addressed to H. R. MITCHELL, *Manager, Zoological Park*, 185th street and Southern Boulevard, New York City.

No effort will be spared to ensure delivery of the regular publications to Members of the Society, but changes of address, forwarding points and non-delivery of mail should be reported promptly. Back numbers of *Bulletin* still in print will be supplied to Members and others at the rate of 30 cents each. Postage and handling, 5 cents extra.

Clark and Fritts, New York, Printers.



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NEW YORK ZOOLOGICAL SOCIETY



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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

Annual Membership in the Society is \$10, renewable annually. Life Membership may be obtained for \$200. A contributor of \$1,000 becomes a Patron; \$2,500 an Associate Founder; \$5,000 a Founder; \$10,000 a Founder in Perpetuity, and \$25,000 a Benefactor.

All classes of Members are entitled to receive every periodical publication, the privileges of the Administration Building with its lounges and reception rooms and gallery of paintings of animals, to attend lectures, open meetings and entertainments, and to be admitted free to the Zoological Park and the Aquarium every day in the year.

Application for Membership may be given to the Director of the Zoological

Park or the Director of the Aquarium, or may be mailed directly to the Secretary, New York Zoological Society, 90 Broad Street, New York City, for action by the Executive Committee.

The Zoological Park is open every day in the year from 10 o'clock in the morning to one-half hour before sunset. Admission is free every day except on Mondays and Thursdays when an admission fee of 25 cents is charged for adults and 15 cents for children between the ages of five and twelve. These days have been set aside primarily for the benefit of Members and their friends who are admitted free on tickets issued with Membership, so that the collections may be seen to the best advantage. All holidays are free.

The Aquarium also is open every day in the year. From April 1 to September 30 its hours are 9 o'clock in the morning to 5 o'clock in the afternoon, and for the remainder of the year, from 9 o'clock in the morning to 4 o'clock in the afternoon. No admission is charged.



A docile and peaceful disposition—the result, no doubt, of having been reared by hand in a pigmy village for the first two years of his life—is characteristic of “Congo,” the Zoological Park’s new okapi.

BULLETIN

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An Okapi Comes to the Zoological Park

For the First Time the New World Sees the Living Link Between
the Extinct *Samotherium* and the Modern Giraffe

WILLIAM BRIDGES

ALMOST thirty years ago, when the Twentieth Century, the New York Zoological Society and scientific knowledge of the okapi were young together, the Society made a bold attempt to bring the first living okapi out of the dark heart of Africa. It failed when the prize was actually in hand, for want of a few cans of milk to keep the baby animal alive. But nourishment has never been lacking in the past three decades for a hope that some day the Zoological Park would be able to exhibit the strange beast that stands midway between the *Samotherium*, extinct ten million years ago, and the modern giraffe.

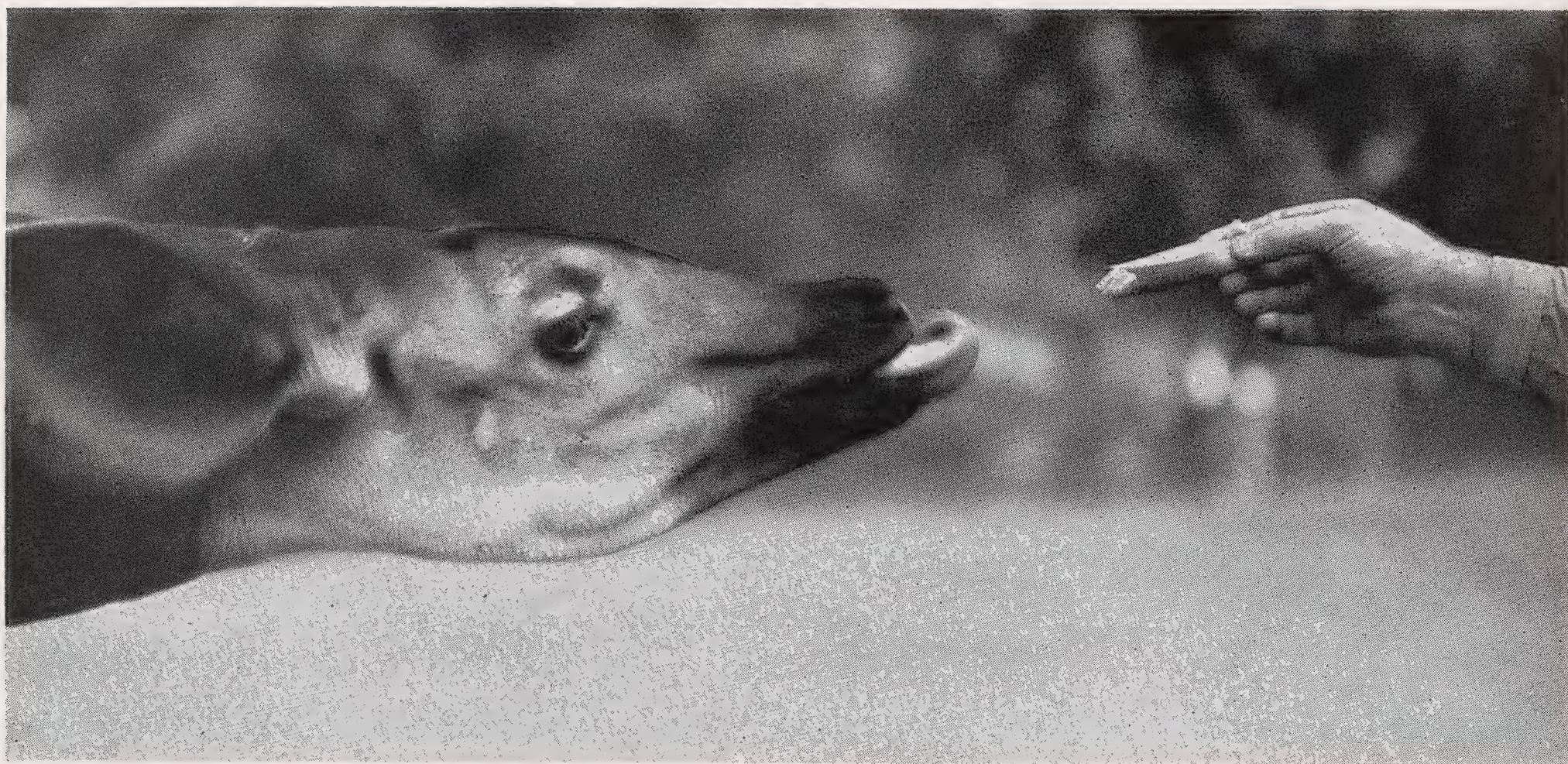
By the circumstance of Belgian control of the restricted area in the Congo where the okapi makes its home, the Antwerp Zoological Garden won the distinction of being the first to display the animal in Europe. Subsequently royal courtesy obtained a specimen for the London Zoological Garden. And then after long negotiations with the Belgian Colonial Administration, Director Blair sailed for Europe early this summer to select one of three okapis captured by the forest-dwelling pigmies near the mission station of Buta and destined for the zoological collections of New York, Antwerp and London.

The hope of years became a reality on Monday, August 2, when he returned with a thriving, healthy male okapi just under two years old. Around midnight of that day the okapi was liberated in a quarantine stall in the Antelope House, adjacent to the equally rare

bongo, and at this writing the fifteen days of regulation quarantine have passed with no hint of disease or serious parasitic infestation. Dangerous as it is to predict the viability of any animal, it is possible to say now, late in September, that the closest observation by the Veterinarian has disclosed no reasons why the okapi should not enjoy a long and healthy life in the Park. Its docility and gentleness, the result of being hand-reared since it was ten days old, have been proved many times, and a weekly examination has revealed continuing good health and contentment.

The okapi is perhaps the only mammal of major importance that has appeared on the scientific horizon for the first time since the beginning of the present century. So thoroughly had the wild places of the world been explored by naturalists and collectors that when the Nineteenth Century drew to a close it seemed all but impossible that any really striking new forms could have been overlooked. Races and subspecies of genera already catalogued by the systematists could be expected, and do, indeed, regularly appear in the technical journals devoted to the recording of such matters. A minuter examination of thrice-trodden ground even today frequently turns up hitherto undescribed species of the smaller mammals, birds and reptiles. But certainly no systematist entertained thoughts of a zebra-striped, giraffe-like link with the Miocene period when the year 1900 dawned.

It was a brief report, only three paragraphs



White men who saw the okapi before a living specimen was known to scientists, described its head as long and "drawn out." The aptness of the description can be seen by this picture of "Congo" as he reached for a bite of food held in his keeper's hand. His long tongue is capable of reaching far beyond his lips and grasping his favorite food, leaves.

long, in the *Proceedings of the Zoological Society of London*, that gave the scientific world the first hint that an important new animal had come to light in Africa. The report was merely one of several presented at a scientific meeting of the Society on November 20, 1900, and embodied a newly-received letter from Sir Harry Johnston, Special Commissioner in Uganda, dated Fort Portal, Toru, Uganda, August 21, 1900. The editorial preface was rigidly noncommittal:

"In the [Great Congo] forest he [Sir Harry] had obtained something like proof of the existence of a very remarkable new horse (*Equus* sp. inc.) which appeared to inhabit the forest."

Then followed this passage from the Special Commissioner's letter to the Secretary of the Zoological Society:

"Reading through Stanley's 'In Darkest Africa' I noticed that he mentions his Dwarf having a name for a horse or ass, and stating that such animals were found in their forests.¹ As the ordinary Zebra type of Equine steadily avoids dense woodlands, this statement seemed

to me a curious one. When I entertained for months the pigmy band which had been captured by a filibustering German (and the restoration of whom to their homes was one of my motives for going into the Congo Free State), I questioned them on this subject and they were very explicit; they told me that they called the animal 'O,'Api' (' stands for a gasping sound like the aspirate or Arabic K). They described it as being dun-coloured or dark grey all over the upper parts of the body, with stripes on the belly and legs. As soon as I reached the Belgian post of Mbéni I began questioning my host, who at once acknowledged the existence of this animal and promised to send me where I should shoot one. They stated that it frequented the deepest part of the Forest, went usually in pairs, was dark iron-grey on the upper part of the body, and had brownish stripes on the belly and legs. I found the Bambuba natives dwelling alongside the dwarfs called it 'Okapi.' The Belgians state that the head is very long 'et très effilée.' One man said that the muzzle was particularly 'effilé'—i.e.

¹ In his Memoir on the Okapi (*Transactions of the Zoological Society of London*, Vol. XVI, London, 1903) Prof. E. Ray Lankester notes: "The following passage in Sir Henry Stanley's 'In Darkest Africa,' vol. ii. p. 442, first drew Sir Harry Johnston's attention to the animal. Stanley says, in reporting on the language of the Congo dwarfs whom he saw in 1888:—'The Wambutti (these dwarfs) knew a donkey and called it "Atti." They say that they sometimes catch them in pits. What they can find to eat

is a wonder. They eat leaves.' From conversation with Sir Henry Stanley during the present year (1901), Sir Harry Johnston has come to the conclusion that Stanley and his companions occasionally caught sight of the Okapi when they traversed the region of the Congo forest on the western side of the Semliki River. . . . The word 'Atti' given by Stanley is apparently a variant of the name 'Okapi,' which Sir Harry Johnston found to be the name for it used by his informants."

drawn out. At first they excited me by declaring that there was a skin lying about which I could have; eventually it was found that the skin had been cut up by their native soldiers to be made into waist-belts and bandoliers. Two of these fragments were found and given to me, and I shall send them home to you by first opportunity. Whatever the animal may be to which these pieces belong, it is not any one of the known Zebras or wild Asses; the pieces of skin unfortunately exhibit chiefly the stripes of the belly and legs. These are very irregular with a chestnut border, and they look as though from above they emerged from a uniform dun or dark grey.

"Unfortunately we did not succeed in seeing a specimen of this animal in the Forest during our short stay, but one of the Congo Free State officials has promised to send me a complete skin and skull."

That first report, entitled "Sir Harry Johnston on a New Horse," was followed by another brief comment on the Okapi at the meeting of the Zoological Society of London on December 18, 1900, when Secretary Sclater exhibited the two strips of okapi hide just received from Sir Harry. The comment at that time was that "... they appeared to be different from any portions of the skin belonging to the known species of Zebra, and, if the account given by Sir Harry of what was said by the natives on the subject was correct, would certainly indicate the existence of a new species of Zebra in this part of the Congo Forest, or somewhere in its neighbourhood."

After completing his examination of the bandoliers, Secretary Sclater came to the conclusion that "whether the native account of the animal from which they were taken is precisely correct or not, the specimens themselves cannot be referred to any of the known species of Zebra and must belong to an undescribed animal, which I propose, provisionally at least, to name after its discoverer, with the following characters, until better specimens are obtained."

Then, in the precise formality of Latin, he set down the characters of the new animal such as he was able to deduce them from the strips of skin and Sir Harry's report:

Supra saturate nigro-cinereus aut fulvus; cruribus intus albicantibus, cruribus extus et lateribus fasciis nigris, utrinque castaneo distincte limbatis, ornatis; capite longo extenso.

The name he bestowed provisionally was *Equus (?) johnstoni*. His choice of the generic name *Equus*, the genus to which the zebras belong, indicated his feeling that the okapi was probably what the stripes would indicate—a hitherto undescribed zebra—but he tempered that designation with a question mark.

The arrival in London on June 17, 1901, of a skin and two skulls of the okapi—forwarded by Sir Harry, whose official friend in the Congo



These drawings reproduce the two strips of okapi hide that were sent to London and by which the animal was provisionally described as a new species of zebra.

Free State had kept his promise to send him more material—settled definitely that the discovery was one of real importance, and that previous guesses identifying the animal with the zebras were incorrect. On June 18, 1901, Prof. E. Ray Lankester of the Natural History Department of the British Museum proposed the genus *Okapia* for Sir Harry Johnston's new animal, and the specific name of *johnstoni*, the name *Okapia johnstoni* supplanting Sclater's provisional name of *Equus johnstoni*.

Subsequently, on November 19, 1901, Prof. Lankester read a résumé of a memoir he had drawn up on the okapi, and stated that the two skulls left no manner of doubt that the okapi was a member of the family Giraffidae.

The constant discussion of the okapi in the scientific and popular press apparently was noticed across the English Channel, for early in 1902 it was learned that the Abbey of Maredsous in Belgium had a strip of hide from the new animal—had been in possession of it, in fact, since December, 1899, when it was received in a group of ethnological curiosities. But no particular attention seems to have been paid to it at the time, even though its arrival in Europe antedated by a year the arrival of two similar strips in London, from Sir Harry Johnston.

The Congo Museum in Brussels also got busy on the okapi problem and obtained a skin and an almost complete skeleton of an adult okapi. These Dr. C. I. Forsyth Major was permitted to examine and on the basis of some minor characteristics he proposed a new species: *liebrechtsi*.

Other remains reached Europe about this time and Prof. Lankester's comparison of various skulls brought out differences which he, too, considered worthy of species separation. He thereupon proposed a third species: *erikssoni*.

For some years the characteristics of *Okapia* were debated in the scientific press, but by 1907 it was fairly well established that there actually was but one species, *Okapia johnstoni*, and that *liebrechtsi* and *erikssoni* had been based upon individual variations at a time when too little was known about the animal. The matter rests at that point today; it is now accepted that the genus *Okapia* is represented by one species only, and that it is *johnstoni*.

Considerable research was done, too, in those early years on the relationship of the okapi to the giraffes. In his earliest reports on the new

animal, Sir Harry Johnston had called attention to skull characters that would relate it to the extinct *Helladotherium*, an early type of the family Giraffidae. After examination of the horn placement in various skulls of the okapi as they became available, Dr. Major in 1902 declared that it was "a stage towards the Giraffe, slightly less primitive than *Samotherium*, and occupying, on the whole, a perfectly intermediate position between the latter and the true recent Giraffes, which are an extreme."

Frequent discussion of the okapi in the scientific and popular press and the exhibition of a mounted specimen in the British Museum had made the public eager to see the living animal, but it was an interest that seemed unlikely to be satisfied for a long time. Reports from Africa indicated that the beast was not particularly rare, but exceedingly shy and difficult to capture alive. Its habitat increased the difficulties, for it was found only in a comparatively restricted area in the northeastern portion of the great West African rain forest, where few white men had occasion or desire to penetrate.

"The Okapi," wrote Herbert Lang in the *Bulletin* some years ago,² "in true hermit fashion, had secured the only retreat that white men would respect, a country that he was forced to acknowledge as the most unhealthy in the world. It inhabits a narrow strip some seven hundred miles long and hardly one hundred and forty miles wide, about seven hundred miles from either coast, the forests of the hilly sections of the many small affluents of the northeastern tributaries of the Congo River . . . Whoever penetrated here was, so to speak 'on the wing,' and wings beat doubly fast across these inhospitable regions. The numerous sportsmen who had visited nearly all parts of Africa found no attraction in these forests. Indeed, the many pale, haggard faces that emerged from the western half of equatorial Africa were no incentive to pleasure-seeking people. The immensity of the wilderness is appalling; for over eighteen hundred miles without a break it stretches more than half way across the continent, from the coast of Guinea to the Ruwenzori. In spite of tropical luxuriance, it is one of the most dismal spots on the face of the globe, for the torrid sun burns above miles of leafy expanse, and the unflagging heat of about one hundred degrees

² Lang, Herbert. In Quest of the Rare Okapi. *Bulletin*, Vol. XXI, No. 3, 1918, Page 1606.



The Lang Expedition in search of the okapi halted on the edge of the forest where the strange animal is found. The country was "the most unhealthy in the world," plagued by unflagging heat of 100 degrees and storms of tropical violence.

day and night, renders the moist atmosphere unbearable. Over the whole area storms of tropical violence thunder and rage almost daily. Here natives have become cannibals, and the graves of thousands of white men are merely a remembrance of where youthful energy and adventures came to a sudden end."

A forbidding land; home of heat, disease and dampness—and the okapi. Nevertheless, white men had penetrated it before, and they went in again. Governmental posts and missionary stations were scattered sparsely through the Congo and the number of skins and skeletons that flowed into European museums from those centers gave promise that eventually a way would be found to bring out a living specimen, for it became more and more certain that in its own chosen area the okapi was not especially rare. By 1907 a young okapi was in captivity at a government post on the Ituri river,³ but it did not survive to reach civilization.

The second okapi captured alive seems to have been the young specimen destined for the New York Zoological Park. In May, 1909, a well-equipped expedition left New York to make zoological collections in the okapi country for the American Museum of Natural History and to capture a few living animals for the Zoological Park—but above all to seek out the okapi. So far successful was the expedition that it actually captured and kept alive for several days an okapi calf.

³ Christy, Cuthbert. *Big Game and Pygmies*. London, 1924. Page 53.

The story of the "Quest for the Rare Okapi" was written by Mr. Lang, the leader of the expedition, in the *Bulletin* for May, 1918. It is an article that well repays rereading, for the wealth of information about the okapi country and the habits of the animal and the pigmy natives.

Near the end of the expedition's five years in Africa, and through the agency of a friendly tribe of pigmies, a calf was brought into camp. The hunters had surprised a mother accompanied by the young one, and in her sudden fright the female bounded away and left the calf to be taken. Nor was it a difficult feat, for "the terrible beast had no other desire than to lick the face of its captor and to suck the fingers held out to him."

Momentarily it appeared that the New York Zoological Park was to have the honor of exhibiting the first living okapi. But it was not to be.

"Within four days my store of eight cans of condensed milk had given out, and it was a severe shock when my messengers returned from Poko and Medje, six and seven days distant, without a new supply," Mr. Lang wrote. "I tried a mixture of rice flour and water, but the calf became so weak that ten days later I lost all hope of saving him. It was a sad disappointment, yet more than ever I was convinced that under proper conditions Okapi could be brought to civilized countries."

And, indeed, it was not long before his prediction came true. About the time the Lang



This is the native method of setting a trap for the okapi. A noose encircles a lightly covered pit into which the animal's leg will drop if he happens to step in it, and then the top of the pit and the noose are carefully covered with leaves and debris to make it invisible.



This is the young okapi that almost came to the New York Zoological Park nearly thirty years ago when the Lang Expedition went to Africa in search of it. The youngster was captured easily and taken to the expedition's headquarters. Within four days the camp's stock of condensed milk was exhausted and the failure of supplies doomed the little animal.

expedition was on the way home in 1915, an okapi only a few days old was brought into the mission station of Buta, on the Uele river, and Mme. Landeghem, the wife of the District Commissioner stationed there, undertook to rear it on a bottle. There was no chance of sending it back to war-racked Europe at the time and the okapi remained at the mission until 1919. From a shy, alert forest animal the baby grew into a tame and almost domestic familiar of the village, wandering at will and gathering much of its own food as it grew out of the milk stage. On August 10, 1919, it reached the Antwerp Zoological Garden, and thus for the first time Europe saw in life and action the astonishing beast that had agitated the scientific world almost twenty years before.

Comparatively few saw the animal, however,

for it survived only about 40 days, dying on September 20, 1919.

Records are not available as to the date of arrival of the second okapi in Europe. Possibly others followed at intervals in the next decade, but if so they were exhibited only at the Antwerp Zoological Garden which would, naturally, have first choice on animals from the Belgian Congo.

In 1931 Dr. Blair was in Europe on a tour of zoological institutions and found that the Antwerp Zoo possessed one specimen. Before he reached Antwerp in the course of his tour, word crossed the Atlantic that another okapi was on its way out of Africa and that it might be possible for the New York Zoological Society to obtain it. Dr. Blair, thus warned, hastened to Antwerp and made every effort to obtain

the animal, but it had been promised by the Belgian Colonial Administration to the Antwerp Zoo and so that attempt came to nothing.

Another living okapi reached Europe in 1935 and the King of the Belgians presented it to the former King Edward, then Prince of Wales, who promptly transmitted the royal gift to the London Zoological Garden. But it, too, was ill-fated, and lived in the London Zoo only from July 31, 1935, to November 4. When it died an autopsy revealed a remarkably heavy infestation by parasites—about 15,000 parasitic worms being collected in only a partial examination of the alimentary canal. A preliminary report on these showed that three species had been known previously from the giraffe, five from domesticated animals, and seven were previously unknown species.

It was a coincidence that on the very day London's first okapi died, in the far Ituri forests the pigmy hunters frightened a mother okapi away from her ten days old calf and carried the little captive into the Roman Catholic mission at Buta to be hand-reared for eventual shipment to Europe. That was the baby that has now come to New York to give the New World its first view of the living okapi.

In May of last year a second young okapi was taken near Buta. Only a few months ago, in the early part of 1937, a third specimen was trapped and turned over to the mission Fathers.

For more than a year Dr. Blair had been in communication with the Belgian colonial authorities about the possibility of securing an okapi and he was informed early this summer that three specimens were ready for shipment. With Mrs. Blair he sailed for Europe on June 12. Their arrival at Hamburg was auspicious; in the Hagenbeck zoological garden there Dr. Blair found two fine specimens of the South American fur seal (*Arctocephalus australis*), which had never been exhibited in the New York Zoological Park, and immediately purchased them, together with a North African ostrich.

The okapis were not due in Antwerp until after the middle of July and in the interim Dr. and Mrs. Blair made a holiday tour of Denmark, Sweden and Germany. They spent a day at the zoological garden in Copenhagen, visited Furuvik near Gefle on the chilly shore of the Gulf of Bothnia, the most northerly zoo in the world—in the approximate latitude of upper

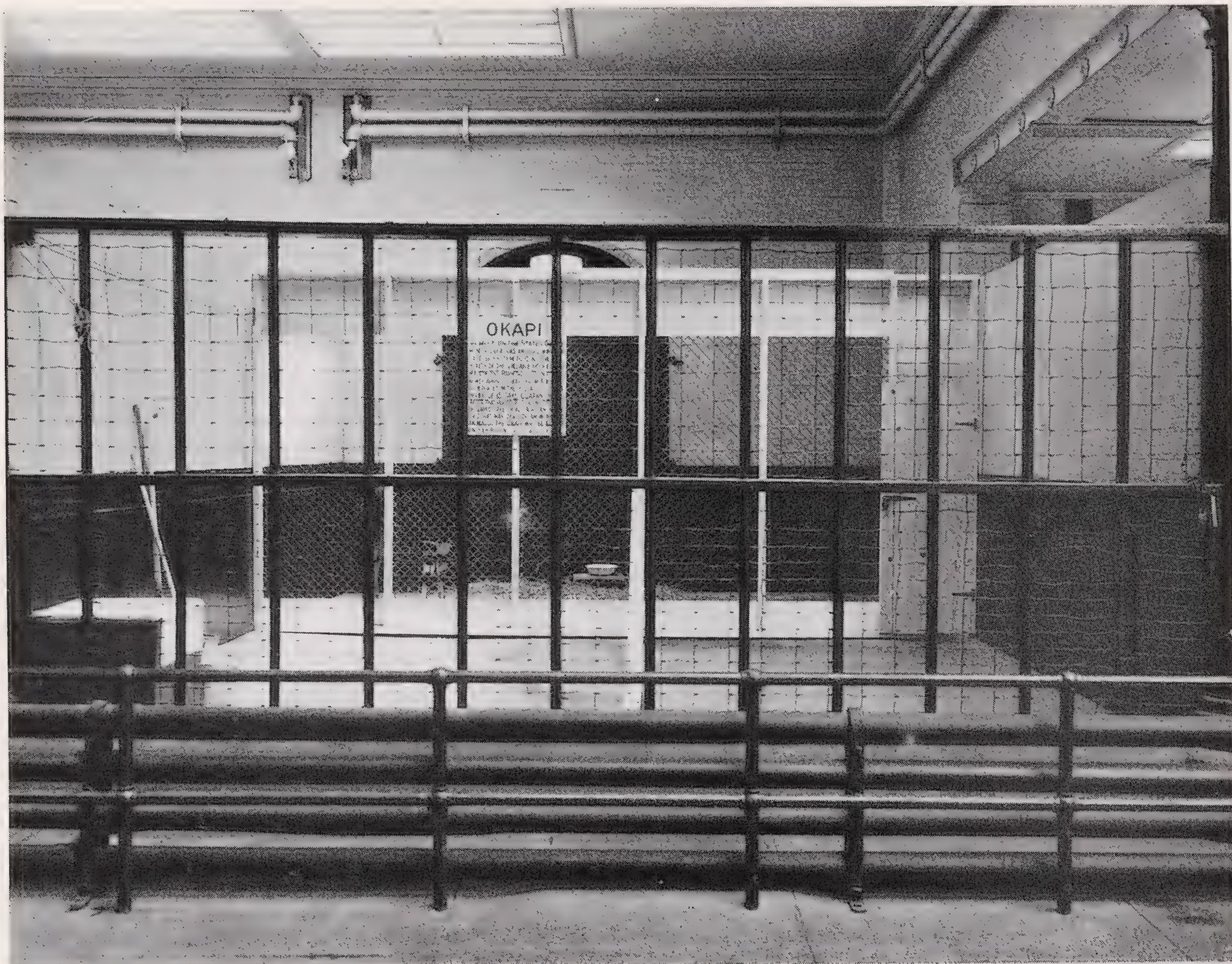
Hudson Bay—and inspected the collection of Scandinavian animals at Skansen, the famous open-air museum and botanical and zoological garden in Stockholm. At Consul-General Johnson's estate at Langsjon they saw nine magnificent specimens of pure-bred European bison, a herd that has been acquired principally from Skansen.

Dr. Blair took advantage of the return trip to Antwerp by way of Germany to consult with the officials of the Internationale Gesellschaft zur Erhaltung des Wisents about the status of the animals to whose protection the Zoological Society has been contributing. He was in touch with Dr. Kurt Priemel, president of the organization; Mrs. Priemel, the Secretary; Mr. H. H. Hauck, the Treasurer, and Miss Erna Mohr, custodian of the records of the wisent. At Dr. Blair's request Miss Mohr is preparing a report which may be available later for the information of the Zoological Society.

Dr. Blair was in Antwerp well in advance of the arrival on July 20 of the S.S. *Thysville* of the African-Belgian Line with the three okapis aboard. With Director l'Ouest of the Antwerp Zoological Garden and Superintendent George M. Vevers of the London Zoological Garden, he inspected the rare cargo. Frère Willem, a tanned, bearded, black-robed Brother of the mission in Buta, was in charge of the animals and had made the entire journey from the heart of Africa to Antwerp with them. He identified the various specimens: a young male captured on November 4, 1935, when so small that it had to be fed from a bottle; another young male taken in May, 1936; and a third male about seven years old, captured in a pit earlier this year.

Dr. Blair's choice immediately fell on the first of the three and after an inspection by Dr. L. Tobback, Veterinarian of the Colonial Administration, had revealed that it was virtually free from parasites and in excellent health, he made it his definite choice. Superintendent Vevers selected the seven-years-old animal for London, and the remaining okapi was taken to the Antwerp Zoo to join the female that had been on exhibition there since 1931—the female that Dr. Blair had tried unsuccessfully to obtain six years ago.

While in Antwerp, incidentally, Dr. Blair examined the female and found that she had developed short, hair-covered horns. In the earlier



Quarantine regulations of the Government demanded that the okapi be isolated from all contact with other animals when it reached the Zoological Park, so a temporary screen wall was set up inside its stall in the Antelope House, and the animal was penned in that restricted space for fifteen days. The wall kept it 20 feet from the public outside the railing.

days of okapi history it was generally believed that only the males possessed horns in their adult state.

Frère Willem predicted that there would be little difficulty in keeping our okapi on its diet during the voyage across the Atlantic, for the animal had been eating regularly despite the confusion and disturbance of the long journey from Buta. The okapis were eight weeks in transit to Antwerp. Late in May they left Buta by truck to Stanleyville on the Congo. At Stanleyville an ancient Mississippi River type of sidewheel steamer transported them downstream to Leopoldville to the railhead, and a slow train carried them to Matidi at the mouth of the Congo. There the *Thysville* picked up the cargo on July 1 to start for Antwerp.

The S.S. *Pennland* which was to carry the

young okapi to New York was a day late in arriving at Antwerp and a Belgian national holiday, a day of unloading, and another day of loading intervened before the okapi could be put on board. Because quarantine regulations would be complicated if the okapi set foot on Belgian soil and thus ran the danger of acquiring the foot and mouth disease, Dr. Blair was compelled to engage a lighter to hold the animal in the harbor for four days until the *Pennland* was ready to receive it.

On the morning of July 24, however, the okapi was put aboard with an ample supply of cabbages, carrots, lettuce, bananas and condensed milk. Frère Willem had run out of cabbages before he reached Antwerp and the okapi ate voraciously when a new supply was available. He accepted milk out of a pan during the



These two views, of the right and left sides of the okapi, indicate that his flank markings of creamy white on a rich dark brown background are not identical. The depth and heaviness of the stripes vary in all individuals to a certain extent, particularly in the regularity of the spacing, but the heavy top band on the foreleg is a characteristic that appears in all photographs of okapis that have been seen here.



Closeup view of the forelegs to show the details of the markings, and how they vary.

whole trip to New York, but changed permanently to a vegetable diet the day after landing here.

Despite the fact that for eight weeks the okapi had been under observation and for most of that time had not touched land, the Bureau of Animal Industry insisted upon a fifteen days' quarantine in New York. The regulation was satisfied by the erection of a wire screen barrier in the animal's stall in the Antelope House, so placed that visitors could approach no closer than twenty feet, and by assigning a special keeper who during that period attended to no other animals.

The okapi was placed in his restricted stall around midnight on August 2, the day that the *Pennland* docked in Hoboken, and remained in close quarters until Wednesday, August 18, when Dr. J. O. Wilson of the Bureau of Ani-

mal Industry pronounced him free from disease and out of quarantine.

The animal's first action on being given the freedom of the large outside corral was to walk toward an overhanging limb of a linden tree and attempt to reach the leaves—for the okapi in his native Africa is a browsing animal and feeds largely on leaves. Since being turned outside he has not been seen to lower his head and charge the fence, an action that was noted once or twice in the quarantine stall. Naturalists say that in Africa okapis thrust their way through the underbrush in that manner, which would explain the exposed and polished tips of the horns in old males.

The velvety texture of the animal's hair and the extraordinary length of its tongue have been noted by everyone who has had anything to do with it here. The tongue can apparently be used to grasp leaves and draw them into the



From the rear, the stripe pattern of the okapi is clearest and most pronounced.

mouth, and is protrusible to such an extent that the okapi can lick its large ears, even though they are set well back on the long head. The anatomist's report on an okapi tongue that was examined in London in 1915-1916 stated that while it was of the ruminant type, it more nearly resembled that of the giraffe in its great length and slenderness. That tongue, from an animal of undetermined age, was 14 inches long and from $1\frac{1}{2}$ to 2 inches wide.

Whether the okapi has a voice is debated. Mr. Lang stated that the young okapi captured by his expedition "bleated from time to time like a sheep," and an anatomical report noted that "The larynx of the Okapi presents a remarkably close resemblance to that of the Giraffe, and by its structure suggests that the animal, like the Giraffe, is practically mute."⁴ "Congo," as our okapi was named by Dr. Blair, has not been heard to make sounds of any kind.

⁴ P. Z. S., 1917 (II), Page 198.

Although the animal has shown a liking for young shoots of the elm, and black birch leaves, it has been established on a regular diet of twelve bananas, six sweet potatoes, twelve carrots, two heads of lettuce and four large heads of cabbage each day. Experimentally the okapi has nibbled a few times at alfalfa and clover hay, but has shown no great liking for it, nor has it shown a need for much water. About a quart a day apparently suffices.

As might be expected of an animal that dwells in the dark undergrowth of the Congo rain forest, the okapi avoids sunshine and habitually seeks out the shady corners of its corral, where its dark body coloration and white stripes lend easy credence to the theory that such exotic markings are an aid in concealment.

The New York Zoological Park has hoped thirty years to introduce the okapi to the New World and it is good to be able to report that the hope has at last been fulfilled by such a magnificent specimen.



For the first few days that he was in the Park, "Congo" expected to be fed by hand, and he is still pleased to take food from a position that will cause him to reach for it, although he does not demand personal attention at feeding time—fortunately for the keeper.

Will the Wild Geese Come Back?

Michigan Is Watching Experiments at the Kellogg Bird Sanctuary and the Seney Refuge that May Repopulate Her Deserted Breeding Grounds

BEN EAST

Nature Editor, Grand Rapids Press

THERE was a time when Canada geese nested commonly in the marshlands of Michigan; south beyond the southern border of the state to the great Kankakee marshes of Indiana; and even casually, early ornithologists assure us, to Kansas and Tennessee. Likewise, there was a time when this gallant waterfowl was a common summer resident in the swamps and prairie sloughs of Wisconsin and Minnesota.

But changes began to come to the Lake States more than half a century ago. Changes that altered the face of the land, and the wild geese did not like them.

Timber was cut. Cleared fields took the place of the forest. The homes of settlers sprang up beside lakes and streams where the geese had known only wilderness and solitude. Fire followed in the trace of the ax, clearing the way for the plow of the pioneer, and the cutover timberlands became blackened wastes. Marshlands were drained and prairie sloughs dried up.

That was the day of spring shooting and market hunting, and there was no sanctuary for the geese anywhere in the newly cleared land.

The wilderness was shrinking, growing smaller and smaller in the Lake States. And the Canada geese are birds of the wild heart. They want loneliness, wide waters and green marshes where man does not trespass. So they quit their ancestral nesting places in Michigan and elsewhere about the Great Lakes and fared on into the north, to rear their young on the barren marshes that look out to the Polar sea, or on the muskeg-bordered lakes of a lonely land in the interior.

For thirty years, maybe forty, maybe fifty, no Canada goose nested in Michigan in the wild state, so far as our records show.

They passed over on the spring flight. They tarried on our lakes, pastured in our wheat fields. But when spring really came they moved on, into the north.

In autumn they returned. Saginaw Bay, one of the greatest wildfowl grounds in the Great Lakes region, saw them in numbers then, as did the St. Clair Flats and a few other favored places. They stayed late in the fall, through November and into December, feeding again in the grain fields along Lake Huron, flying over Lake Michigan dunes to the cornfields.

But for all those years the Canada geese were unknown on the lakes and marshes of Michigan throughout the summer.

A decade or so ago Michigan made up its mind it wanted the geese back. Not just as visiting migrants, following our flyways and loitering on our marshes in autumn and in spring. As summer residents. As natives, nesting and rearing their young. And so the state launched a careful, systematic program to restore the king of waterfowl to the summer marshes that once knew his kind.

The program got under way at the W. K. Kellogg Bird Sanctuary, located on the shore of Wintergreen Lake near Battle Creek, in the southern part of the state.

The Sanctuary is operated by Michigan State College, in charge of Dr. Miles D. Pirnie. Before he took over his job there he was State Ornithologist for the Michigan Conservation Department and spent considerable time studying Michigan's waterfowl supply and the problem of increasing it.



On a small refuge in the farmlands of southern Michigan, Henry M. Wallace built up a flock of Canada geese which he turned over to the Biological Survey early in 1936 for transfer 400 miles to the Seney refuge. This is part of the Wallace flock on its home grounds before it was moved—an area that was not particularly well suited to the nesting needs of geese.

When Dr. Pirnie went to the Sanctuary in 1931 the place owned a sizeable brood flock of Canada geese, either pinioned or wing-clipped. On that flock Pirnie pinned his hopes of re-establishing the Canada as a nesting bird in the marshes of southern Michigan, from which it had been absent for probably more than half a century.

The pinioned geese nested and reared their young regularly on the small lake in the heart of the Sanctuary. Each spring since he went there Pirnie has permitted a part of the year's crop of young geese to have the run of the place, unpinioned and unclipped.

Throughout the summer, of course, they remain with the parent birds. Fall brings the wild migrants down from the north and many of them pay the Kellogg refuge a visit, loitering there for weeks, safe from guns and sharing the feed of the tame geese. But even the departure of these guests for wintering grounds farther south is not sufficient to lure many of the Sanctuary-hatched youngsters away. For the most

part they spend the winter with the pinioned flock.

But when spring comes and the wild flocks wing over, northward bound, the story is different. The call of the summer nesting grounds is a compelling one and the bulk of the full-winged young geese are unable to resist it.

Some of them mate with pinioned or clipped refuge birds and are held captive by a tie stronger than the urge to migrate. Still others mate with full-winged birds like themselves but remain at the Sanctuary and nest there, probably because it is home.

Nor do all of those that leave wing their way into the distant north. More than one pair travels out a few miles from the refuge, seeks out a suitable location on lake or marsh and settles down for the summer. It is those pairs and their offspring that are carrying out Dr. Pirnie's plans.

Each year since 1931 a number of these full-winged Canadas have been allowed to leave the Sanctuary. And more and more frequently re-

ports have filtered back of wild geese nesting about the adjoining countryside. Most of the reports have come from the Gull Lake region, within a few miles of the Kellogg place. But some have come from lakes twenty, thirty and forty miles away. And the number of the reports increases summer after summer.

Dr. Pirnie's plan is working. By allowing the young geese to leave, free either to go north or to nest near home, he is gradually building up a stock of "native" wild Canadas in that section of the state. It seems reasonable to believe that many of their offspring will return to the marshes where they were hatched and so the wild flock will continue to grow, year by year.

At about the time Dr. Pirnie launched his project, another game refuge in southeastern Michigan was undertaking much the same task. On his Migratory Waterfowl refuge in Oakland county Henry M. Wallace of Detroit was building up a big flock of semi-domestic Canadas to serve as a breeding stock and to lure wild birds to the place. Many of these geese nested regularly on the refuge and the flock increased until it numbered more than 300 birds, many of them full-winged and free to roam as they pleased.

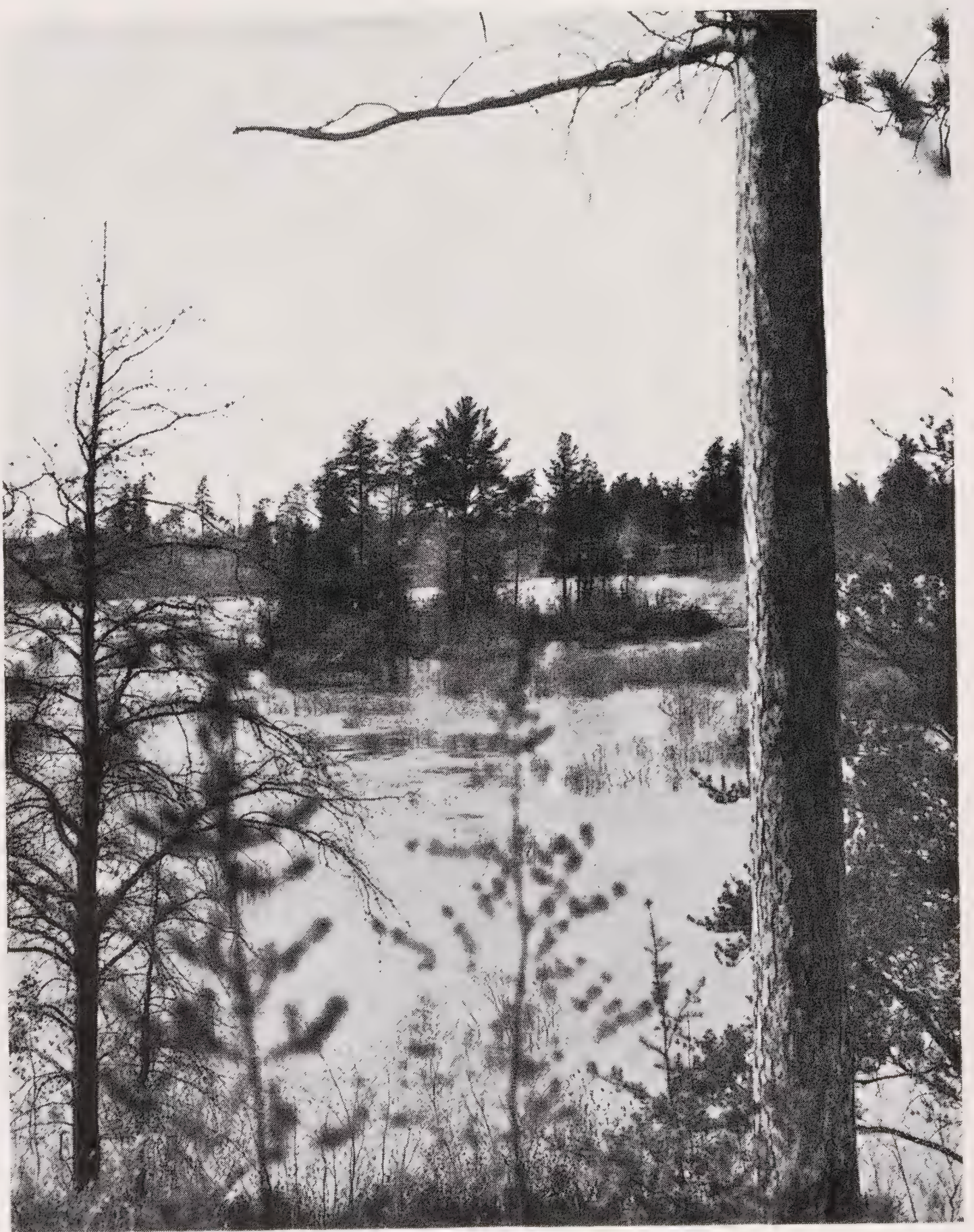
Then the United States Biological Survey stepped into the picture.

In the Upper Peninsula of Michigan, a few miles south of Lake Superior, was a vast, flat region of something more than a hundred thousand acres, known as the Seney marshes.

Once it had grown a valuable crop of white and red pine, on the sandy ridges and dry plains threading through the swales and marshland. But the pine

had been cut long ago and when the timber harvest was complete land speculators had taken over much of the tract. They had dug ditches and drained sandy acres not worth the cost of a year's taxes. They had sold, to inexperienced, would-be farmers dwelling in distant cities, land too poor to repay one plowing.

The useless drainage ditches were taken over finally by wandering beaver colonies and for years the denuded, fire-swept acres of sand and dry marsh, river and wet slough lay idle and barren, affording some good prairie chicken hunting within the last decade and a half but otherwise of no use to anyone.



When the floodwaters were turned into the old Seney marshes, the result was this—a paradise for Canada geese in search of nesting sites and isolation. This shows one of the ponds created in the old marsh after the Biological Survey took charge.



Feeding time for the Wallace flock of Canada honkers in their new home in the Seney Sanctuary. At first the geese were placed in an enclosure, but a few of them were capable of flight and escaped over the fence into the neighboring marsh. Several pairs that had escaped in this manner nested on the Seney marshes during the past spring.

In 1935 the Biological Survey looked the area over and decided it had possibilities as a waterfowl factory.

It was typical of brushy marshes in the northern states from New York to Minnesota. Marshes that were producing limited quantities of ducks—very limited. They should be producing more. Why? Because the breeding stock that returned from the southern flight each spring was too small, too depleted by gunning and other factors? Because such marshes lacked sufficient water to provide attractive nesting grounds? Because they were deficient in natural duck foods? Because of predators? Or for sundry other unknown reasons?

No one knew the answers. Here, the Survey decided, was a chance to find out. Here was a great natural laboratory ready to be set up and put into operation, that could be expected to show how to make brushy marsh areas in the north yield bigger duck crops.

The Survey was establishing a chain of waterfowl refuges across the continent, anyway, as part of its great duck and goose restoration

program. It proceeded to link the Seney marshes into that chain.

The Michigan Conservation Department pledged its co-operation. The purchase of land was begun and the creation of huge pond systems got under way.

When the refuge is completed it will contain some 90,000 acres. Dikes are being built to restore water levels lowered years ago by the drainage ditches, to flood large areas of the marsh. Brushy nesting islands will dot the ponds. Duck food is being planted, pondweed, sedges and wild millet. An environment attractive to waterfowl is being created scientifically.

And early in 1936 Henry M. Wallace gave his entire flock of Canada geese outright to the Biological Survey, for transfer to the Seney refuge.

The geese were moved four hundred miles to their new home in trucks before the end of that winter. It was a home far different from the small refuge in the farmlands of southern Michigan where Wallace had built up the flock.

It was more nearly the kind of country in



The "No Trespassing" sign is unmistakable as this goose defends its nesting site on the Kellogg Sanctuary at Wintergreen Lake in southern Michigan, the second of the refuges on which the hopes of a restoration of Canada geese as a breeding species in Michigan are based. The Canadas are now nesting freely in the neighborhood of the Kellogg refuge.

which wild geese might be expected to be content. It was wilderness, peopled by prairie chickens and deer, beaver and porcupine, ducks and even a roving handful of sandhill cranes.

The geese were placed in an enclosure but a few of them, capable of flight, escaped over the fence into the adjoining marsh. Several such pairs nested on the refuge that first spring.

I visited two of the nests in May. In both cases the Canadas were nesting as wild geese under natural conditions. One pair had chosen a location on a small dry island in a shallow slough, the other pair within a few yards of a small creek that threaded a wide reach of the marsh.

The first goose deserted her eggs while we were forty or fifty yards away, walking off across a wet bar to disappear in a willow thicket,

honking her distrust and resentment as she went. Her mate failed to put in an appearance.

The second Canada was made of sterner stuff. The gander at this nest slipped quietly away at our approach, swimming off down the creek and leaving the goose to face the invaders by herself. Maybe he was aware that she had no need of his aid.

She flattened herself on the nest, head and neck outstretched over its rim, until we were only a yard or two away. Then she stood suddenly and swiftly erect, hissing in rage and defiance, her wings spread like broad gray shields, her heavy black bill drawn back in readiness to strike.

We worked about the nest for more than a half hour without driving her so much as a foot from her eggs and when we finally took



These goslings are the offspring of a pair of Canada geese that wandered off from the Kellogg Sanctuary. Some pairs have nested within a few miles of the refuge; other reports have come from lakes as many as forty miles away, and the number of birds that are scattering to favorable breeding places is apparently increasing from summer to summer.

our leave she was still standing over the nest, steadfast in its defense and loud in her opinions of cameras and camera hunters and trespassing humans in general.

It is on such geese as that, nesting under wild conditions in the great marshes of the refuge, and on their offspring, allowed to come and go full-winged and unhindered, that the Biological Survey bases its hopes of accomplishing ultimately in the Upper Peninsula and the Lake Superior district generally what the Kellogg Sanctuary is doing for southern Michigan, re-establishing the Canada goose as a nesting species.

The young geese hatched at Seney will migrate south on the fall flight, in all probability, or some of them may winter over on the refuge with their elders. In either event, when the time arrives for the spring flight, and they return from the south or scatter to their summer homes, it is believed many of them will forego the long journey into the north for the

delights of a nesting place in the region where they themselves were fledged.

If this happens, gradually it will result in building up a breeding stock of native Canadas in the big marshes of the Upper Peninsula, where once the wild Canadas found conditions entirely to their liking.

The hopes of sportsmen, bird lovers and others who have watched hopefully the work done with the Canadas at Seney and at the Kellogg Sanctuary were raised this spring by the nesting of a pair of wild geese along the Pere Marquette river in Mason county, a few miles inland from Lake Michigan, more than a hundred miles north of the Kellogg place and nearly two hundred south of the Seney marshes.

The exact origin of this pair will never be known. Both were full-winged and unbanded. All efforts to trace them as semi-domesticated Canadas from a sanctuary flock or former decoys owned by someone in the Pere Marquette river district failed. They were wild birds but



These are the first wild Canada geese known to have nested in the Pere Marquette River district in Michigan in forty years or more. Whence they came no one knows, but they chose their nesting site, hatched five goslings, and eventually led them away to the marshes along the lower part of the river. They raise hope that the wild geese will come back.

that does not necessarily mean they were not sanctuary-hatched.

Dr. Pirnie believes they were the offspring of his flock or of some small flock kept elsewhere in southern Michigan, allowed to go unbanded and unhindered when the time came for their first spring flight. He makes no attempt to band all of the young Canadas that roam at will over his Sanctuary.

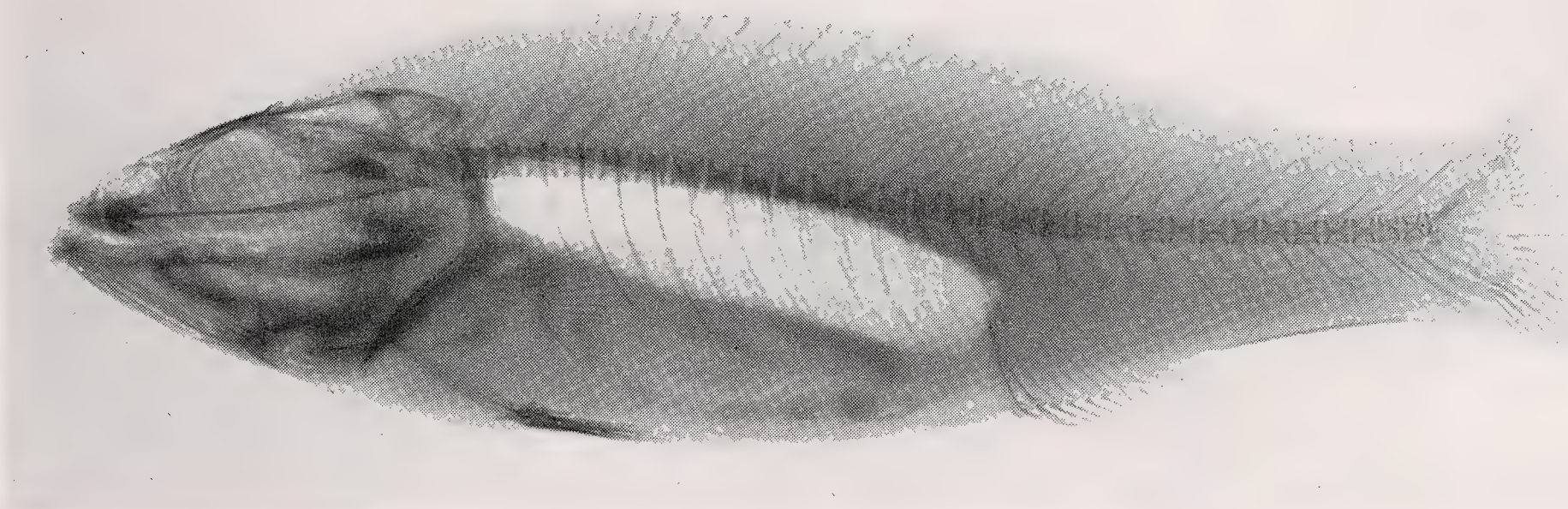
In any event, the two geese built their nest near the river's edge, defended it lustily from the few intruders who found them, hatched five goslings and led them away to an unknown destination in the marshes along the lower Pere Marquette.

They were the first pair of Canadas to nest in that district in forty years or more, and the

isolated record they set sent soaring the hopes of all who want to see the wild geese established in their former haunts once more.

Will they come back, then, those gallant, wide-winged waterfowl of the white cheeks and the bugle-clear voices, to the green summer marshes of Michigan and the rest of the Great Lakes country?

There are many who believe they will, many who believe that the suitable marshland areas of the Lake States can be made to produce again an annual crop of the gray geese that American wildfowlers recognize as the king of all the clan. And among the many who believe it are those who manage the Kellogg and Seney refuges—the wildfowl men of Michigan State College and the United States Biological Survey.



Black Bass (Micropterus dolomieu).

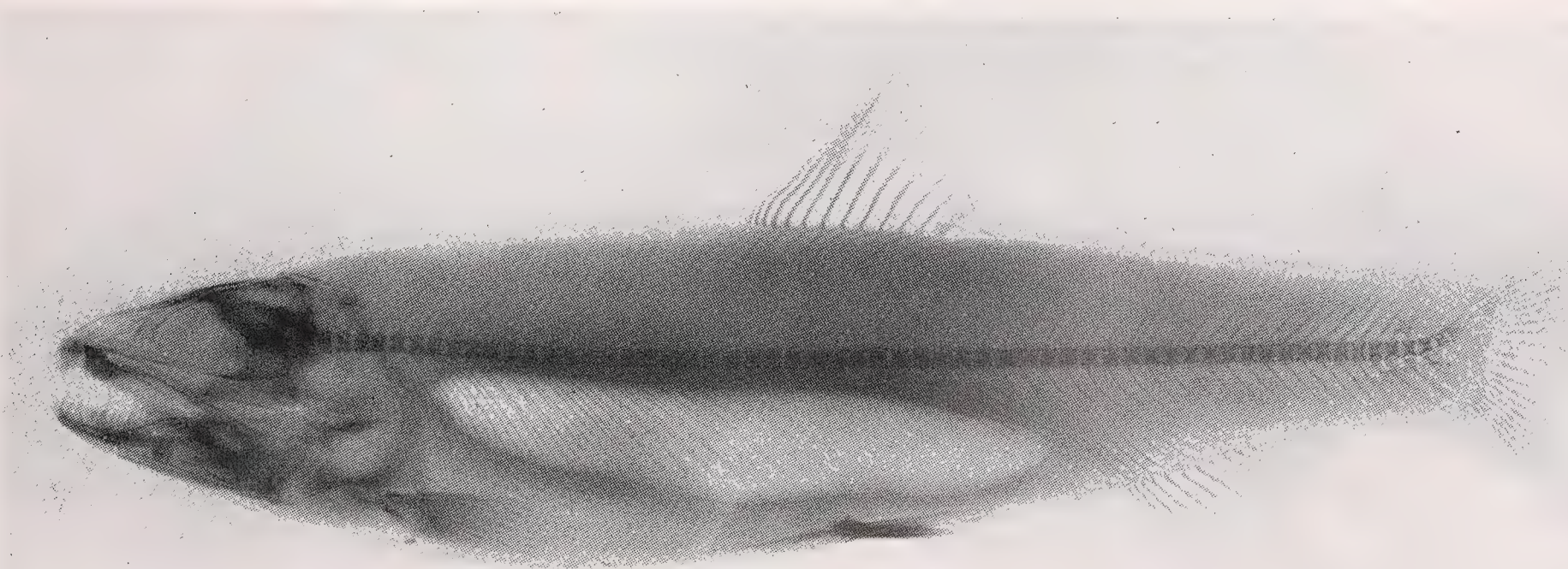
Photographs Showing the Swim-bladder in Fishes

C. H. TOWNSEND

THE swim-bladder in fishes, a sac filled with air or gases, enables them to adjust their specific gravity to different depths. It varies in size and shape in different fishes. Many years ago the writer had some radiographs made chiefly to show the skeletal features of fishes, only a few of which were published (*Annual Report N. Y. Z. S.*, 1905). A recent examination of the series shows that they portray the swim-bladder very clearly.

The swim-bladder is found only in the bony fishes, but not in all of them. Flounders, which

do not maintain an upright position, do not have it. Sharks and other cartilaginous fishes also lack the swim-bladder. Its position in the body cavity, under the backbone, is familiar to those who prepare fishes for food. Norman (*History of Fishes*) states that "There is no other single organ in any group of vertebrates which performs such a variety of functions as does the air-bladder of Bony Fishes." In some fishes it is used to make sounds. The drumfish has a special muscle, which, vibrated rapidly across the air-bladder, produces the drumming sound



Brook Trout (Salvelinus fontinalis).



Yellow Perch (*Perca flavescens*).



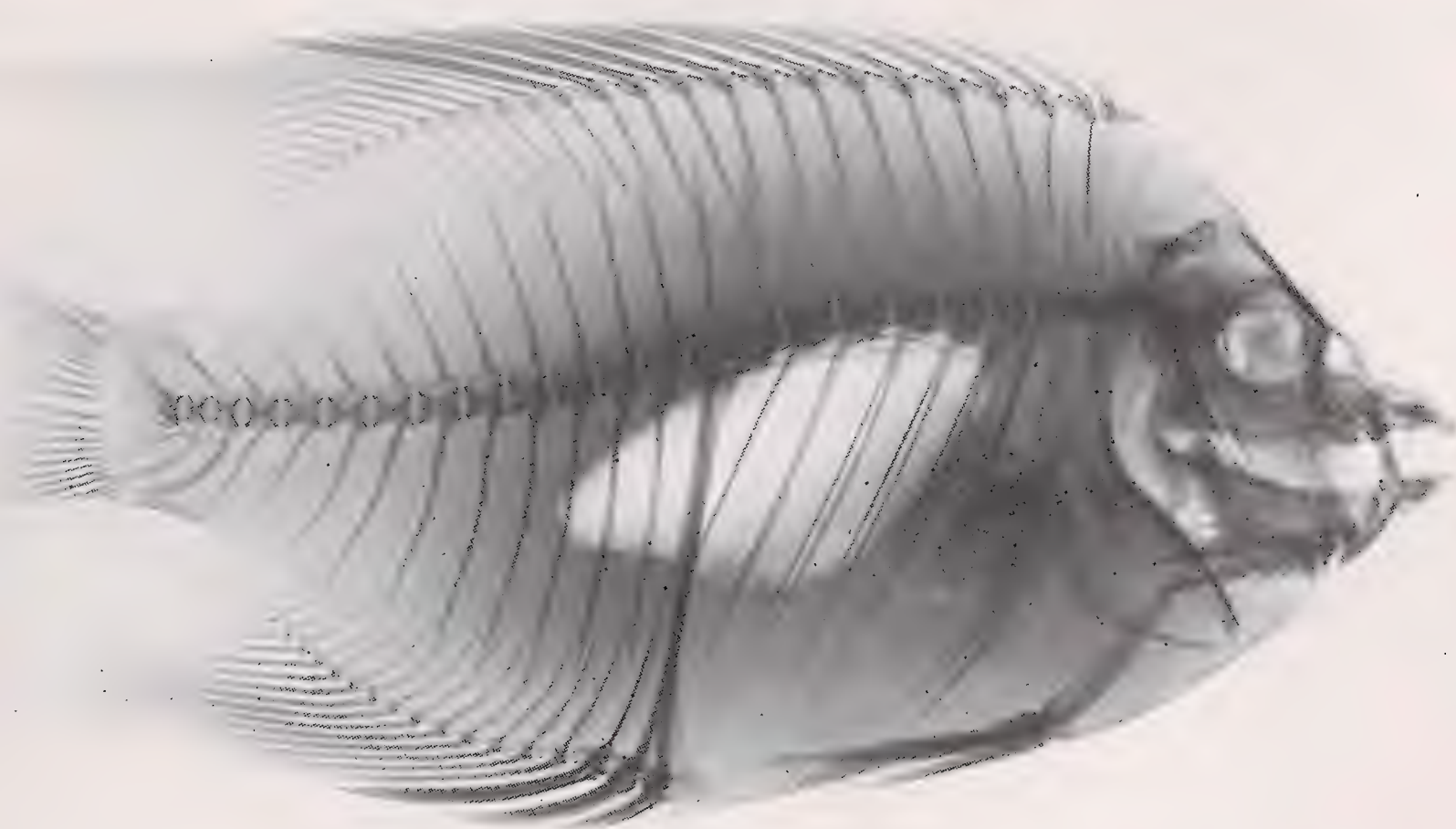
Goldfish (*Carassius auratus*).



Parrotfish (*Sparisoma*).



Squirrelfish (*Holocentrus ascensionis*).



Queen Angelfish (*Angelichthys ciliaris*).

that gives the fish its name. Many other fishes, such as grunts and croakers, make sounds in similar ways.

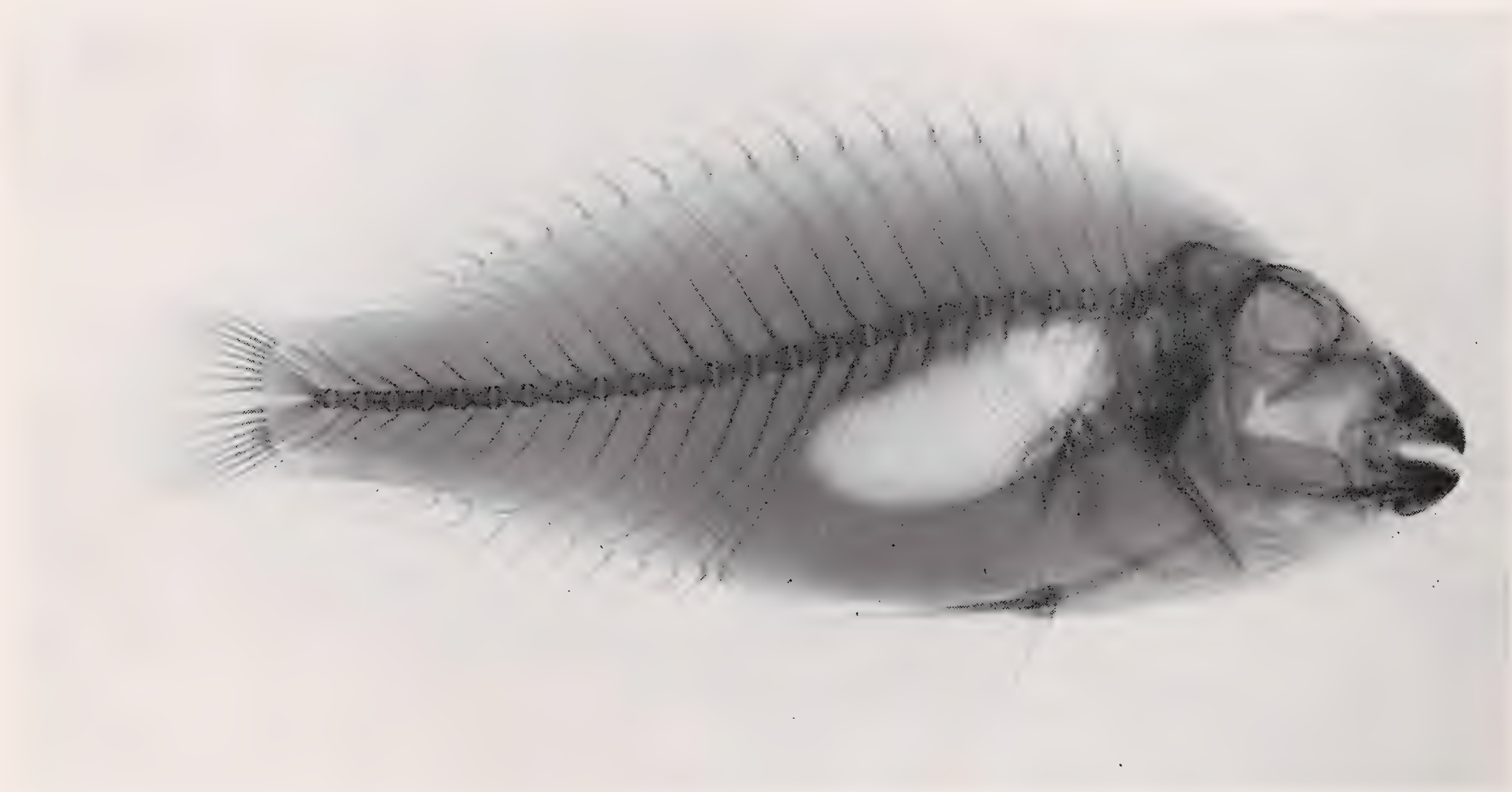
I once slept on board a small schooner anchored in a shallow Central American harbor, when the sounds made by fishes on the bottom were audible all night. It has been suggested that the myth of the song of the sirens originated in the sounds made by fishes. The swim-

bladder is of use to fishes in too many ways to be enumerated here, but one of them is its connection with the sense of hearing in fishes. Mankind has long used it in the preparation of isinglass and other commercial products, to say nothing of eating it as the "sounds" of the codfish.

It is to be regretted that the radiographs at hand do not include some of the fishes having



Gray Snapper (*Lutianus griseus*).

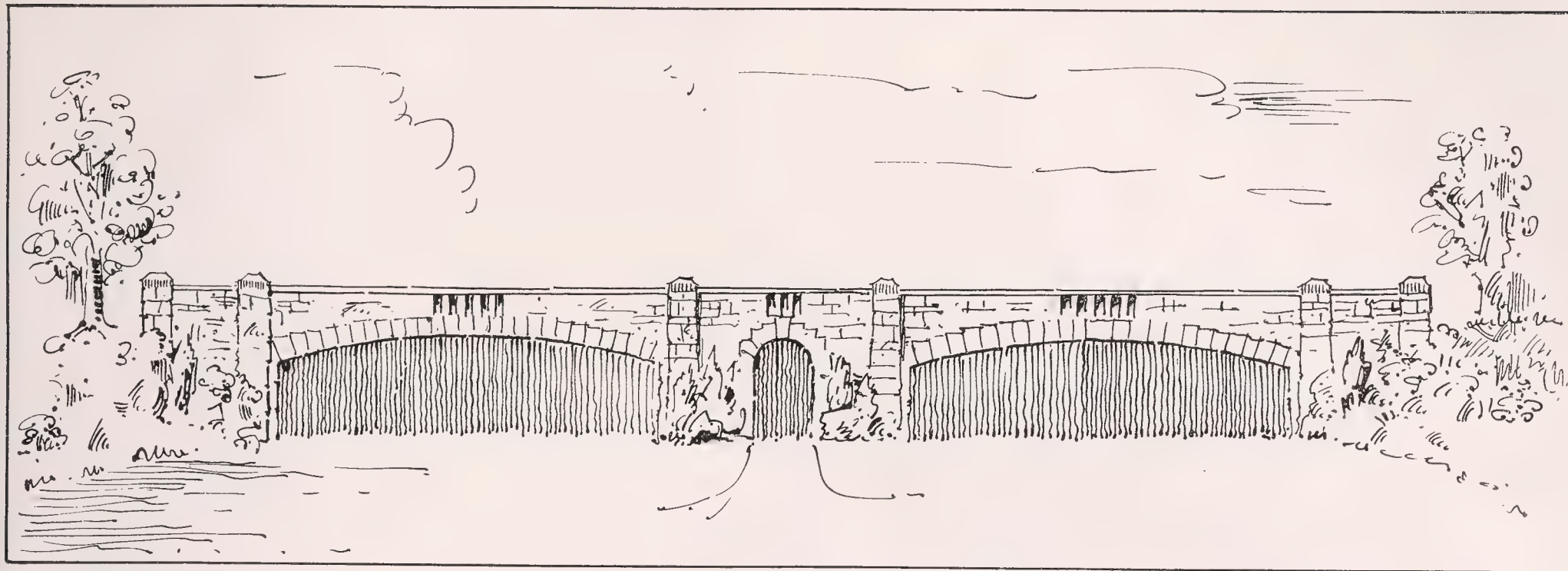


Green Parrotfish (*Sparisoma viride*).

air-bladders of unusual form. In the gars it extends the full length of the abdominal cavity; in the bowfin it is very large; in many it is small.

The main use of the swim-bladder is to enable the fish automatically to adjust its weight to that of the water in which it lives. The deeper the water the greater the water pressure.

In some fishes the swim bladder has more or less to do with respiration. It is also in constant use as a float. The flesh of fishes being heavier than water, they would tend to sink without the buoyancy it affords. How could the pike lie motionless near the surface without a swim bladder?



The new bison shelters as they will look when permanent stone construction replaces the present wooden buildings. This is a view of the shelters from the east, or corral, side.

Plans for a Wild Cattle Collection

An Outstanding Exhibit Can Be Made, and the Bison Range Improved
at the Same Time, with Slight Effort

W. REID BLAIR

NO zoological park in the United States has a really satisfactory exhibit of wild cattle at the present time. Specimens of the gaur, gayal and banting, the impressive Asiatic representatives of the group, are available on the wild animal market and can be obtained by anyone with the facilities for exhibiting them properly. I am taking this opportunity of laying before the members of the Society a plan that will enable us, with the expenditure of comparatively little effort, to create an installation that will permit a magnificent exhibition.

It calls for the remodeling of the present Yak House and the building of a walk through the bison range, over the top of a new and permanent bison shelter.

The ancient stone building that now serves as a shelter for a thriving herd of yaks is not accessible to the public, nor can it be said to be an attractive feature of the landscape. Both of these conditions would be remedied by changes of the kind we propose.

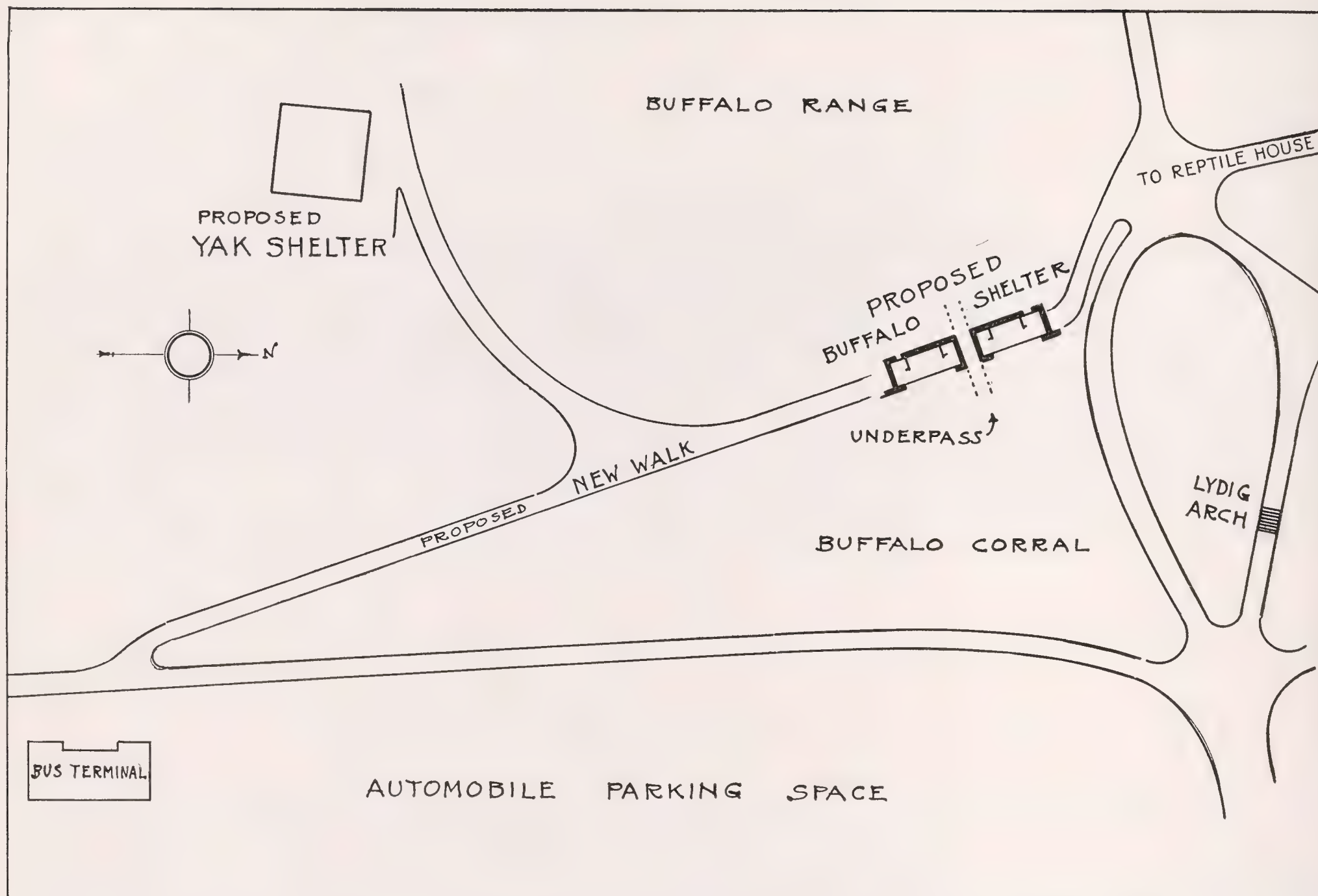
Reference to the map on the next page will make clear how we plan to give access to the

Yak House. From a small plaza just south and east of the Rocking Stone a new walk will be laid across the bison range in a curve that rejoins our present path in front of the Bus Terminal and tearoom. A spur will lead to the Yak House.

The present wooden bison shelters, even more unsightly than the Yak House, are directly in the path of the new walk, and the filling and grading necessary to the creation of the walk give us an opportunity to rebuild them in a permanent form. The architect's drawing shows what an attractive appearance they will have, with the walk running above them. Stone faced on the east side, they will be two in number, divided by an underpass. Through the underpass the bison may leave the corral on the east side of the walk and enter the big range on the west side.

The west side of the shelters, incidentally, will be banked with earth and planted with low bushes that will not obstruct a view of the range from the walk.

By means of the new walk we expect to make



The diagonal walk and the spur approaching the Yak House are the new features of this diagram of the animal areas in the southeastern corner of the Zoological Park. The diagonal walk follows the path of the present corral fence and does not reduce the range area.

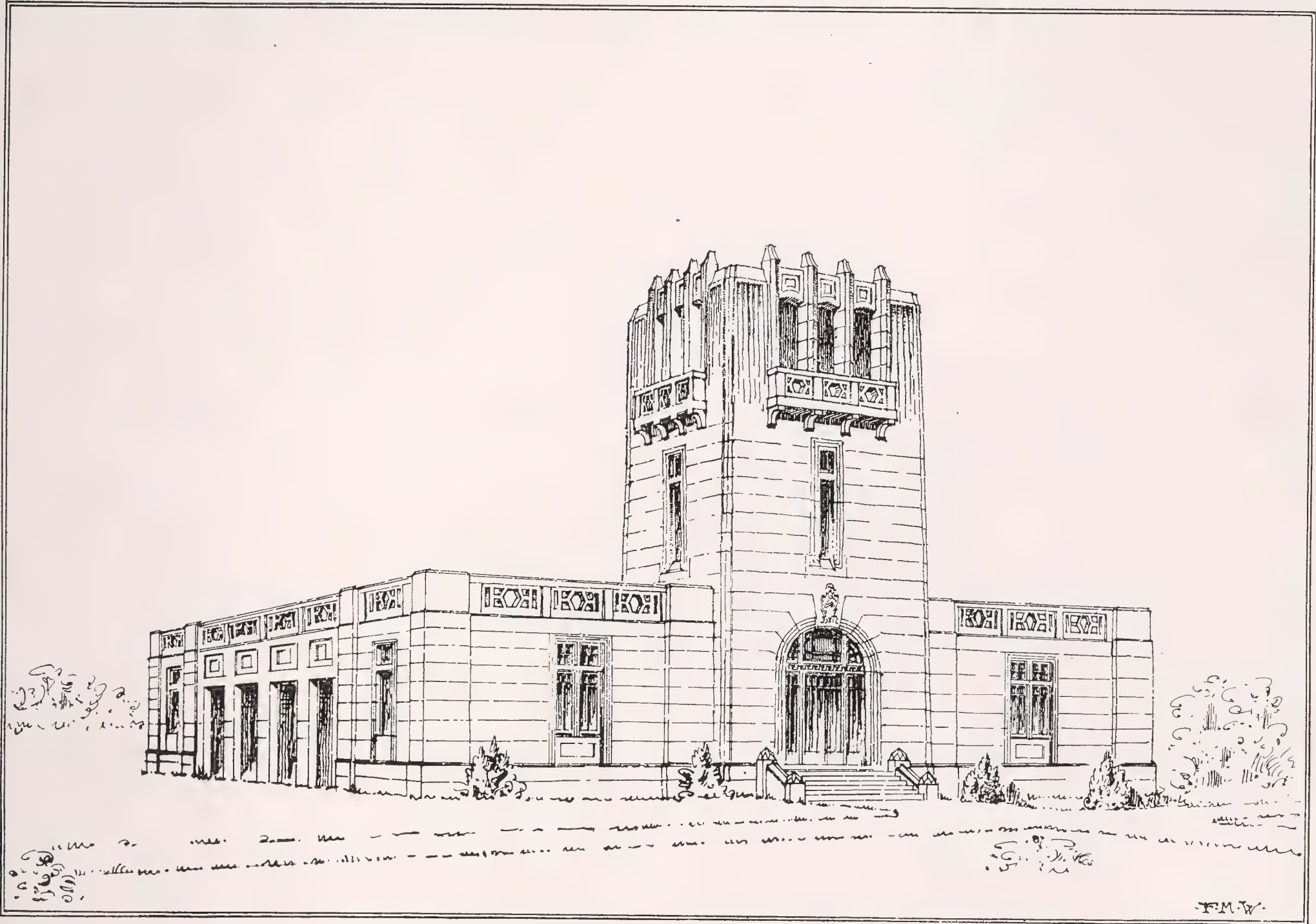
our bison collection really visible to the public at close range—and without sacrificing more than a few feet of the space devoted to them. The triangular corral, in which the herd spends very little time, already stands between the public walk and the area where the bison roam. The new walk will skirt the edge of the range itself, and thus bring visitors appreciably closer to the animals without reducing their range by any more than the mere width of the walk.

We intend to make our bison display well worth seeing by increasing our present herd of four animals to a maximum of ten head. Our bison herd at present is at its lowest ebb in almost forty years. The herd, as older members will recall, was founded in 1899 by the purchase of seven bison from "Buffalo" Jones, and has been added to from time to time by bison from the Whitney herd from the October Mountain Preserve in Massachusetts, the Corbin herd in New Hampshire, and a few animals from the Wichita herd. Our collection

reached its peak in 1907 when we had 42 head of bison. This was reduced by 15 when the American Bison Society, founded in the Park, sent 15 head as a nucleus to the Wichita National Forest and Game Preserve, and again in 1913 when we sent 14 head to the Wind Cave National Park in South Dakota.

Our present bison stock is not really representative of the magnificent proportions of the American bison and we need new blood; this can be obtained from one of the great national herds in the West, at no expense except for crating and freight.

Ranges that were originally intended for wild cattle adjoin the bison range on the south side, and in the center of the former is the present Yak House. Built of stone, it suggests the architecture of Tibet, the native home of the yak, and to that extent is appropriate to its purpose. But with modifications that are neither extensive nor costly, its usefulness and beauty can be greatly enhanced.



By facing the present Yak House with stone and constructing a tower, its appearance will be radically changed—for the better. A storage room is on one side of the entrance and a keeper's room on the other. Entrances to the shelter stalls open on the other three sides.

Briefly, our plan is to retain the present building, which is sixty feet square, and to face the walls with stone or brick to their present height of one story, after remodeling the interior to provide a more economical arrangement of stalls. On top of the building we would erect a tower of approximately one story height. A stairway would give access to this from the inside, and also to the roof of the first story. From the roof the visitor may obtain a comprehensive view of the wild cattle collection, and from the elevation of the tower gain a panoramic view of the whole south-eastern corner of the Park.

The creation of a really inclusive collection of wild cattle is a goal well worthy of the Society. From the very beginning it has been our endeavor to make our exhibits as complete as possible within group limits. By exhibiting simultaneously the gayal, gaur and banting the Asiatic wild cattle of the world would be fully

represented. The anoa, or pigmy buffalo of the Celebes, is already exhibited in the Small Deer House.

The gayal, gaur and banting have been called "the handsomest existing representatives of the genus," *Bibos*. The gaur, which we have never exhibited, is the tallest of all the oxen; old bulls are known to stand six feet at the shoulder. A native of India and Malaysia, the gaur is known as the seladang in the latter part of its range.

Both the gayal and the banting, the first from Assam and probably south to Tenasserim, and the second from Java, other Malay islands, the Malay peninsula, Burma, Siam and Cochin China, we have exhibited in the past, but never in such a collection as would be possible were the Yak House remodeled for them.

The yak herd at present quartered in the Yak House, would of course continue to occupy it and share the range.

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All pictures not otherwise credited are from the photographic collection of the New York Zoological Park and the Aquarium.

NOTES FROM THE ZOOLOGICAL PARK

Raven Escapade

LEE S. CRANDALL

Our birds *do* have wings and in spite of the concentrated effort of the entire staff of the Bird Department, they sometimes take advantage of accidental opportunities to use them. Escapes from our collection are infrequent enough to cause excitement always and sometimes embarrassment as well. The first state of mind was aroused on a quiet summer morning when Keeper Atkin of the Aquatic Bird House reported that some mischievous vandal had broken the lock that fastened the door of a cage containing a particularly fine Northern Raven, and that the bird was missing. Later in the morning, the raven was seen disporting himself in the tops of the tall oaks nearby. He scorned all efforts to coax him down and finally, evidently finding that his wings were as efficient as he had hoped, flew southward. Next day, he was observed in the act of peering through the skylights of the Reptile House, quite possibly with the idea of food in mind. But this did not develop further and with his latent faculties under control, our raven definitely departed.

No word of him was heard for two weeks. Then we learned that a large black bird, possibly a raven, had established himself in Fort Tryon Park, in the upper reaches of Manhattan. A hasty trip across the Bronx not only confirmed the rumor but determined the identity of the bird. It was our truant, beyond a doubt. The Northern Raven, once tolerably common in the northeast, is now a rare bird. So rare, indeed, that only a single specimen had reached us previously, and that one many years ago. This sec-

ond bird was obtained from Maine in 1933, after much effort, correspondence and securing of official permits. Such difficulties left us no alternative. Any Northern Raven at liberty in New York was our raven. But to claim was one thing, to capture was another.

The fugitive had made Fort Tryon Park a bird paradise for one. Hand-reared from the nest, he was bold and fearless. His handsome black coat and friendly manner had made him many friends and on the day we rediscovered him, he was just finishing off the wolfing of a half pound of chopped steak, with a dismembered broiler ready for the next course! He accepted these delicacies from the hands of his admirers, apparently with the greatest confidence in their good intentions. So it seemed that there should be no great difficulty in laying hands on him.

Next day, two keepers visited the park, equipped with tempting bits of raw beef and a landing net. The idea was to offer the meat with one hand, with the net held behind the back, and to engulf the trusting bird when he came up for the proffered tidbit. But the first attempt showed that his boldness was tempered with caution of superlative degree. He would take the meat, but only when it was held in fingers fully extended and the other hand behind the back *not* holding a net. A flexed arm, or two arms held in front, he would not approach at any price. Nothing could induce the bird to abandon this position, so we decided to attempt to outwit him with a method even his crafty brain could not circumvent.



And this is the wily truant, safe at home once more and firmly gripped in a leather-gloved hand—for he can bite effectively.

There is a drug known as Nembutol, which will produce anesthesia when taken in the correct amount. All we had to do was to get the bird to swallow the proper dosage and the problem would be solved. Unfortunately, when the aid of Dr. Schroeder was sought, we learned that the proper dosage is still a matter of doubt—Nembutol is too new. However, after careful calculation, the Veterinarian weighed out what appeared to be a sufficient quantity of the drug to produce the desired result. This we craftily inserted in a tasty bit of beef, which was greedily swallowed by the unsuspecting bird. Twenty minutes' waiting and the expected blinking began. A minute more and the bird's wings began to droop—he was ours! There was a rush of two eager keepers, armed with nets. The raven staggered, moved reluctant wings, made the top of a three-foot wall. And then, just in time to avoid the swoop of a swinging net, he launched dizzily outward, over a sharp incline. His effort was just enough to make the top of a tree reaching up from below. His feet grasped clumsily but held. And there he sat, well out of reach, until his brain had cleared again. If only that dose had been just a pinch larger!

And now excitement was replaced by embarrassment. The press is a fine ally when things are done well but a thing to be avoided when they aren't. We were assailed by the dreadful fear that our reporter friends might get wind of our futile efforts and have things to say about the bird men who had been outwitted by a raven. For this raven now soared to mental heights never reached before by one of his kind. He had never heard of Nembutol, but one lesson had taught him well enough to know that he did not like it. We used every disguise we could think of, every device, but Nembutol he would not take. Any sort of meat, yes; any sort of meat containing our drug, no. There just wasn't any way to make him do it!

Then desperation showed another way. We waited for an afternoon of drenching rain, when no one would venture forth with food for an embattled raven. Next morning, before well-wishers were likely to arrive to take the edge off the raven's appetite, a keeper was dispatched to the park with a larger dose of the drug concealed in the choicest piece of meat it was possible to find. We figured that the bird would be ravenous and that our trap was so cleverly concealed that even his keen brain could not detect it, or that he would not be able to resist the meat even if he suspected a trick.

Our keeper was back in the Zoological Park almost before he had time to reach Fort Tyron Park, it seemed to us. The grin on his face told us from a distance that the bird was in his basket. Nembutol had been too much for our wily raven, at last!

But no! It was a different tale. The keeper had carried out his instructions well. He had given the bird a clean piece of meat, which it had accepted readily. He had then given the bird the carefully drugged piece, which it had taken readily, mumbled suspiciously—and buried in the ground! Our young keeper had done his bit and might have returned discouraged, as on other days. But now he was on his own, and

free to devise another plan. He was close to the wall from which the bird had launched its escape in the first attempt. Enlisting the service of the inevitable small boy who had been hanging about, he had the net taken around behind the wall. The keeper then walked over, enticing the unsuspecting bird with promises of food. Seating himself on the wall, he settled his right hand on the grip of the net, still out of the bird's sight. A piece of meat dropped near his dangling feet, a rush by the hungry bird, a swoosh of the net and the raven hunt was over.

A Pigeon Comes Home

The sense of direction possessed by homing pigeons has produced many surprising stories, but one of the most remarkable instances of that strong homing instinct occurred recently at the Zoological Park.

During the World War we kept quite a number of homing pigeons for the Government, intending to breed them for war work. The war ended before they were ready for service, but the pigeons remained at the Zoological Park and more or less as a hobby I continued to train them and fly them.

Among them was a handsome hen of the kind known as a "Blue." My records show that she made one long flight during that period of training. She was released at Salisbury, N. C., and returned to her loft in the Park in one day, a distance of 506 miles by airline. That, incidentally, is a good but not an exceptional flight for such a bird.

Eventually it became necessary to dispose of the entire loft and the pigeons were given to various fanciers. My Blue hen went to a pigeon fancier at Utica, New York.

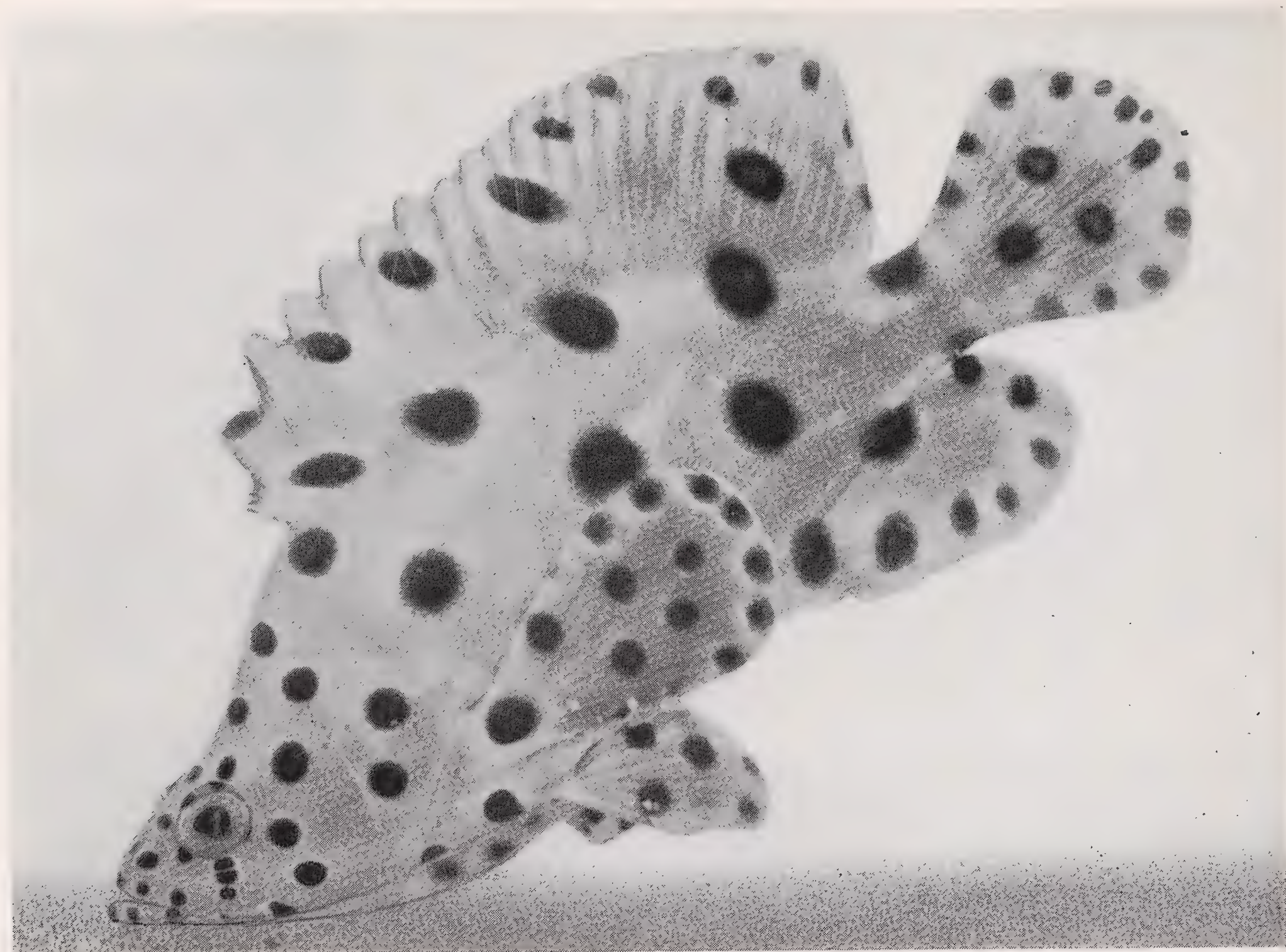
Two years passed and then, one afternoon, a keeper came to my office with the announcement that a strange pigeon was fluttering around the Pheasant Building where the old pigeon loft had been. I went down to investigate—and found the Blue hen from Utica.

There was no doubt about it being the same bird, for not only was its numbered band still intact, but I had been particularly fond of it and remembered it perfectly. But what was it doing back here in New York?

Immediately I wrote to the Utica fancier and inquired what had happened. He replied that the Blue hen had escaped from his loft, that he had kept the bird confined ever since he received her, and had not trained her in a single flight.

The only conclusion, therefore, was that the bird's homing instinct or homing sense, whatever it may be called, had brought it back to its original home after two full years—and even though it had never been trained for flight in the direction from which it had come.

If the bird had been given to someone in the direction of Salisbury, or along the general route over which it had been trained, its return home would not have been so extraordinary, even after a lapse of such a long time. But to return from a new direction after two years of close confinement appears to demonstrate that the force that pulls a homing pigeon toward its home loft is indeed a hardy instinct or sense.—L. S. C.



The "polkadot" pattern of the Panther Fish is most apparent in its light phase, as it appears here. Sometimes in the stress of excitement the fish blushes to a pale rosy pink. Some specimens are colored a rich maroon. The fish grows to about two feet in length.

A Panther Fish at the Aquarium

In a collection of fishes from the eastern seas the Aquarium has received a small specimen of the panther fish, *Chromileptes altivelis* (Cuvier & Valenciennes), picked up in Sumatra and sent to New York via Germany. So far as we have been able to learn, this is the only specimen of this strikingly marked fish to reach American shores. The specimen was almost pure white when received, except for the vivid pattern of "polkadots" in rich black. Since then it sometimes blushes to a pale rosy pink under excitement. Large specimens, the species reaching somewhat over two feet in length, are occasionally reported to be a rich maroon.

Received on April 12, it has shown a most vigorous, or perhaps one should say a prodigious, appetite, accompanied by a satisfactory growth. The pose seen in the photograph is more or less characteristic. It spends most of its time resting quietly in odd-angled positions close to or in actual contact with the rockwork of its aquarium. The only noticeable movement is the fanning of its large, limber-looking, spatulate pectoral fins made more prominent by their regular edging with seven marginal spots which are light circled.

In a short time it learned to recognize as a

dinner signal the chopping sound made by the attendant as he minced bits of food close to its tank. Now it is only necessary to drum on the back of the tank to cause the fish to rise to the surface in expectation.—C. M. B., Jr.

Books by Two Curators

Books by two members of the Zoological Park staff were published during September. "The Making of a Scientist" by Dr. Raymond L. Ditmars (Macmillan) reviews the hobbies and animal adventures that have entered into his career. "Wild Animal World: Behind the Scenes at the Zoo" by Dr. Ditmars and William Bridges (Appleton-Century) is chiefly about the Zoological Park. * * *

The pronunciation of the name of the Zoological Park's latest and rarest arrival, the Okapi, has apparently caused the public some difficulty. One telephone inquiry as to when the animal would be placed on exhibition began: "When can I see your new kaopi?" * * *

By an error in transcription, the pelican and cormorant flight drawings in the July-August *Bulletin* were wrongly credited. They were made by George Swanson.

PRESENT DAY MAMMALS

By CLAUDE W. LEISTER

GENERAL readers as well as students in zoology and biology classes who have often been puzzled by the relationship of animal groups will find this an invaluable reference work—a handy book to have in one's general library, and a useful adjunct of textbooks.

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What does it look like?

How big is it?

What is it related to, and why?

Where does it come from?

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Zoologica: Scientific contributions of the New York Zoological Society. Volumes I-XXI are complete and indexed. Volume XXII will be issued during 1937, in quarterly parts. *Zoologica* is sent to members on request.

[*Zoopathologica*, Scientific contributions of the New York Zoological Society on the diseases of animals, has been discontinued and future papers on animal pathology will appear in *Zoologica*. *Zoopathologica* is complete in Volumes I and II, which are indexed.]

Annual Report: Documents, reports and pictures of the work of the various departments of the Park and the Aquarium. As a rule it contains articles of scientific value and considerable general interest.

Gallery of Wild Animal Paintings in the Zoological Park: A handsomely illustrated catalogue of the gallery in the Administration Building at the Park, which Members may receive on request.

A classified list of the publications of the Society, with subject headings of articles printed in the *Report*, *Zoologica* and *Zoopathologica*, as well as reprints from them, will be furnished on request. Some of the publications have become exhausted and orders for any issues will be governed by this circumstance. Orders for any of the publications should be addressed to H. R. MITCHELL, *Manager*, *Zoological Park*, 185th street and Southern Boulevard, New York City.

No effort will be spared to ensure delivery of the regular publications to Members of the Society, but changes of address, forwarding points and non-delivery of mail should be reported promptly. Back numbers of *Bulletin* still in print will be supplied to Members and others at the rate of 35 cents each, postage prepaid.

Clark and Fritts, New York, Printers.





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EVER since its founding in 1895 the New York Zoological Society has attracted the active interest of persons who believe, with the founding group, that instruction and entertainment and important scientific achievement can go hand in hand through the maintenance in New York City of well-balanced collections of mammals, reptiles, birds and fishes from all parts of the world.

The Society is taking a prominent part in the conservation of wild life all over the world but especially in North America. The work it has done in the collection of Heads and Horns is of great scientific value, as are the accurate pictures of wild life in its galleries.

In the Society's work of gathering, maintaining and exhibiting its collections, as well as its constant efforts in behalf of conservation of wild life everywhere, every Member shares, and through the privileges of Membership and the Society's publications is rendered an accounting of the work in which he participates.

The New York Zoological Society invites the Membership of all persons who wish to lend financial support to the purposes for which the Society was founded and to cooperate in a tangible way toward the future development of the Zoological Park and the Aquarium.

Annual Membership in the Society is \$10, renewable annually. Life Membership may be obtained for \$200. A contributor of \$1,000 becomes a Patron; \$2,500 an Associate Founder; \$5,000 a Founder; \$10,000 a Founder in Perpetuity, and \$25,000 a Benefactor.

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Where the two worlds meet . . .

BULLETIN

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Impressions — 3,000,000 Years in 3 Days

A Visit with William Beebe at the Zoological Society's Oceanographic Station,
Including Experiences Under Water Off Nonsuch, Bermuda

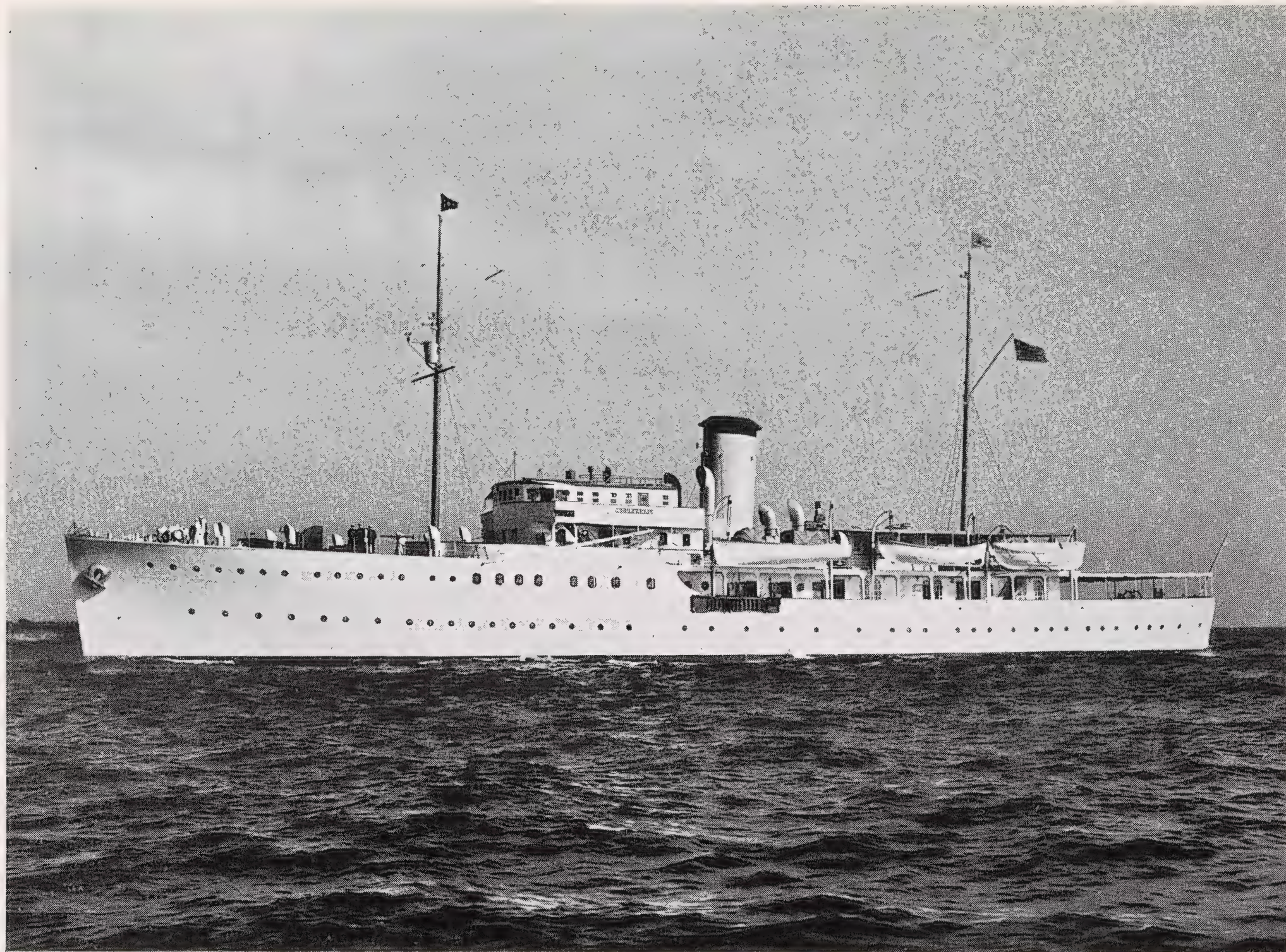
FAIRFIELD OSBORN

CUTTING a summer sea, white plumes at her bow, the splendid yacht *Nourmahal* bore south-easterly leaving the New England coast a vanishing blue thread beneath her stern. Her owner, and frequently her navigating officer, Vincent Astor, sharpened our appreciation of the smiling ocean of our first day at sea by telling us that the Caribbean, mother of hurricanes, was sending north one of her first of this season's storms and that, although the latest meteorological reports indicated we should pass ahead of it, nevertheless we might still discover for ourselves what a "blow" really was. Stars of the early evening soon dimmed behind wisps, then blankets, of clouds and by midnight the *Nourmahal* was nosing her way through a sixty-mile gale. What a gallant ship, built for such work—the wind and sea seeming not to trouble her at all! Her owner spent the night on the bridge—and only turned in after we had safely passed through to easier seas. The next morning, gradually, one by one, the ship's company made their appearance with the humble pallid look of those who have borne their sufferings in private!

I think of the *Nourmahal* as a true boat of the sea, constructed and manned for any passage, including, from a zoological point of view, a number of large tanks on her upper decks, equipped with a circulating sea-water pumping system, for the transportation of marine specimens.

Our landfall, the Bermuda Islands, was made the following day, only forty-eight hours, despite the hurricane, after leaving Block Island astern. What a contrast: incredible sea colors from cobalt blue to shell green, dotted islands, reefs, white shores crowned with the dark green of cedars and the pink of oleanders; those islands known to the early navigators as the Devil's Islands, because of their hurricanes and myriad reefs, known to American tourists as a "five-day heaven," known to scientists as a perpetual heaven for the study of the ocean's myriad life.

The ninth year, this, of the work of our Station in Bermuda—the Tropical Research Department under Dr. William Beebe—the Oceanographic Station so generously initiated by Harrison Williams and the late Mortimer Schiff. For days my mind had teemed with countless questions. Having of course read Dr. Beebe's books, as well as various articles by him and members of his staff appearing in this *Bulletin* and in *Zoologica*, having talked with him as a close friend for hours on end and over many years regarding his work, I wondered eagerly what a view of the Department's work "on the ground" would tell me, what new significances I might find. My three days at the station abounded in answers, "answers" came at me unexpectedly from every angle of space and time. I had been thinking too much in the present—making insufficient allowances for the



Vincent Astor's yacht Nourmahal is familiar with most of the waters of the world, for it has cruised to many distant places with parties of scientists aboard. Her upper decks carry tanks equipped for circulating sea water, for the transportation of many kinds of marine specimens.

infinite past and the endless future—and so I have been pleased to call this sketch “3,000,000 Years In 3 Days.”

Probably no more than a handful of you who read this have been welcomed by William Beebe at the particular spot on this earth's globe where he happens, at that moment, to be in the midst of his work. His welcoming greeting, intensely eager, is more than “So glad you're here with me.” It conveys “Yes, you're here, I'm glad—for now I can share with you the world I see, and show you at least some of the miracles to which we are trying to find answers.” And so it was as the small sea-launch the *Skink* (vicariously named in honor of the ubiquitous land lizard of the islands) came along aside the *Nourmahal* in the harbor of St. George with the “Director” waving arms and calling his greetings from her prow. After inadequate expressions of appreciation to my host for my voyage,

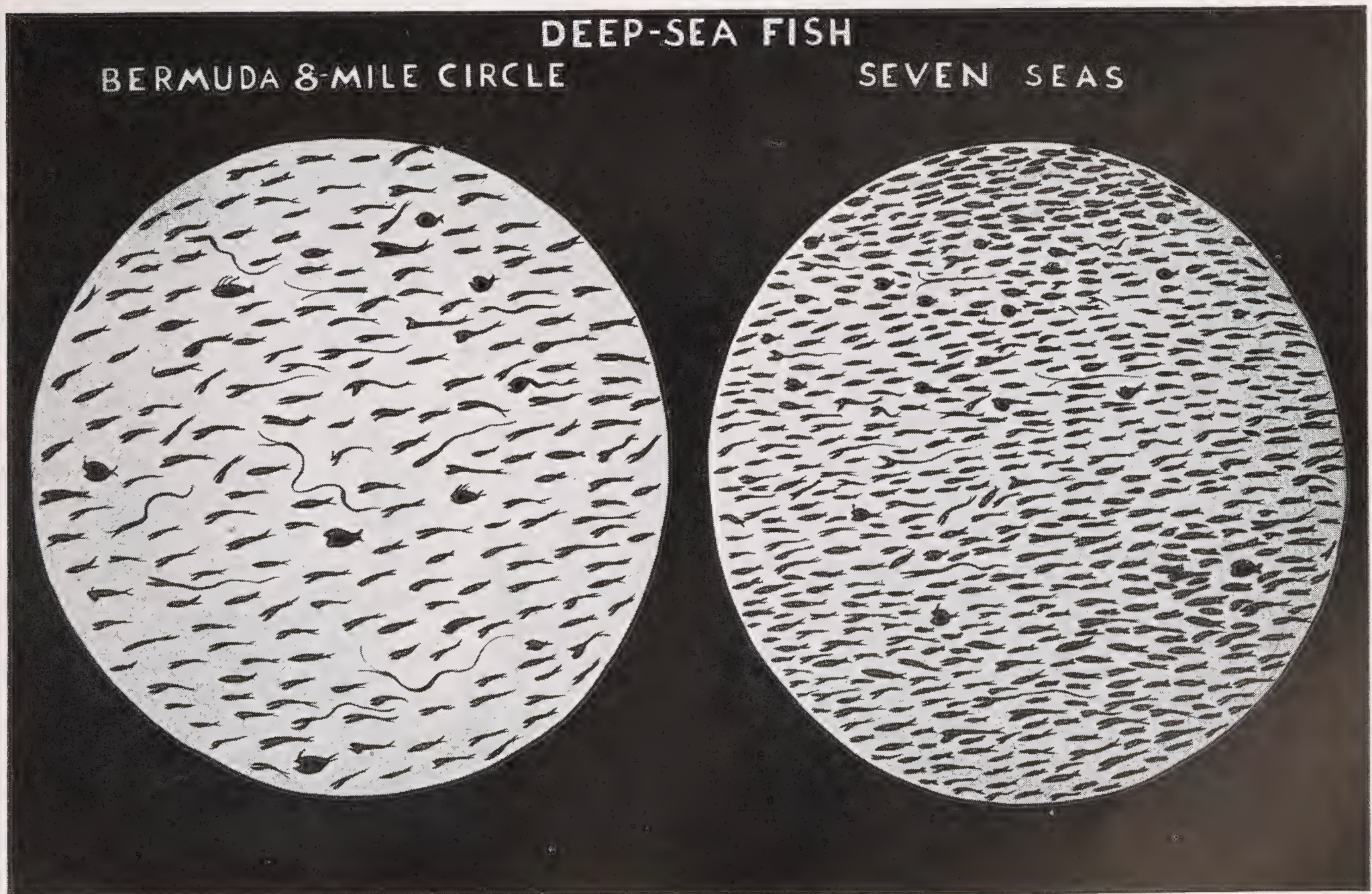
and farewells to my fellow guests, the *Skink* put off from the lee of her towering sister and nosed her way along the island-dotted shore to the Department Station. This property, New Nonsuch, was acquired by Dr. Beebe several years ago and is so situated that it commands a panoramic view of the outlying islands and of the ocean beyond. A small wharf and a boat-house for lodging equipment and aquaria nestles below the main building, the whole ground floor of which is devoted to the laboratory. As I entered, greeted by the staff members, John Tee-Van, Jocelyn Crane, Gloria Hollister and George Swanson, the Director exclaimed: “Here, this will orient you into the world you've come to” and pointed to a large painted diagram on the wall.

“This drop of sealing wax, a millimeter in diameter, represents an eight-mile circle of the ocean there”—pointing out the window—“and

this large circle, eight feet in diameter, represents all the oceans of the world in one. The figures in it represent all the known species of fish in all the world's oceans, and here in this smaller circle, which is just an enlargement of the drop of sealing wax, are figures representing the species that have been found in our eight-mile circle just out there beyond Nonsuch Island, a full third of all those known from all oceans. So in a water area one five-millionth of the earth's seas, we have taken one-third of all the abyssal fish known to science. Do you get it? It's the same idea as the intensive study of a quarter square mile of British Guiana jungle. The life-forms in almost any given spot on the earth's surface are innumerable and to a considerable degree correlated with corresponding life forms the world over." I stood, fascinated, thinking of the China Sea, the Mediterranean, the ocean off the east coast of Africa, endless waters, rippled by faint breezes or harrowed by mighty storms—to our casual eyes just another ocean, but beneath, beneath—peopled by innumerable

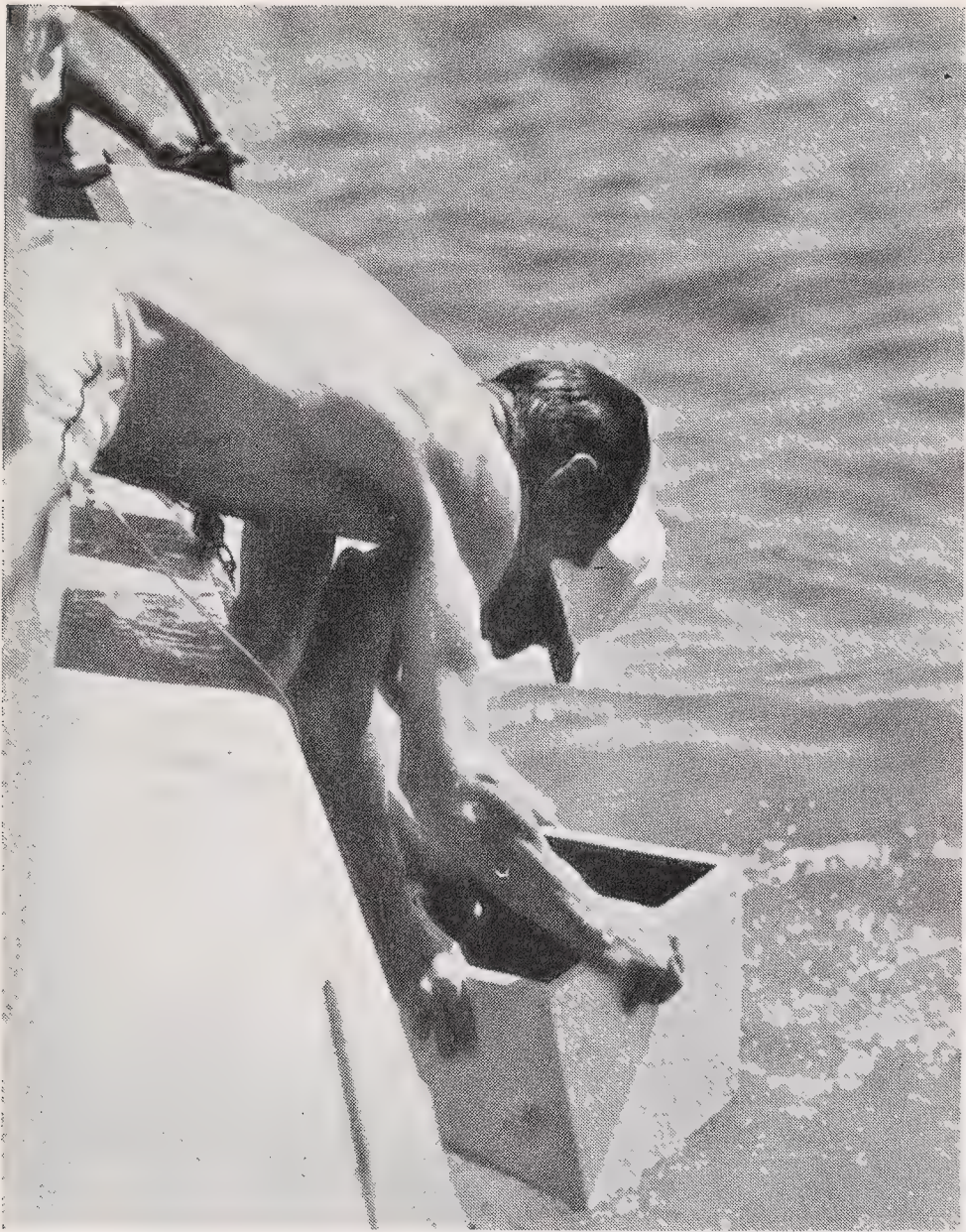
forms, ever moving, slowly changing, one mile depths, five mile depths, life illimitable, slow adaptations through tens and hundreds of thousands of years—and there, out the window, only half way to the horizon, the teeming eight-mile circle, a world in itself.

Left alone awhile, I wandered around the laboratory—a mass of receptacles, microscopes, indices, work-sheets, colored drawings, books of reference, bottles full of strange specimens, typewriters. "Ye Gods!" I thought, "I must have more clues"—and was interrupted by a shout, "Come on, just time for a swim before supper." I have swum in the Pacific, Atlantic, Mediterranean, North Sea, and in glacial streams in British Columbia, but never with a "water-glass." I have swum to play, to get cool or to get clean, but never to study. From now on a swim without a water-glass will be no more than a gesture! Off the pier-end we plunged or climbed, as our temperaments dictated, and swam toward a submerged reef. There we floated, and peering through the water-glass,



Drawing by George Swanson

This diagram pictures comparative numbers of species of mid-water, deep-sea fish from an 8-mile cylinder of water off Nonsuch, Bermuda (220 species), and elsewhere from all the seas of the world (about 670 species). The cylinder represents about one five-millionth of all seas.



Through the water-glass a new world appeared, lucent and colorful, while brilliant fishes weaved in and out of the reef.

saw, as if through a suddenly-opened magic door, a new life-world, lucent, colorful. Scores of brilliantly colored fish weaved below me, in and out of the reef rocks; surgeons, angels, parrots, wrasse, demoiselles, grunts, intent on their own goings and comings, heedless—flippantly so, to my man-mind—of my shadowy frame floating above them.

But here one's range of vision extended only a few feet. What of the morrow, plunged helmeted, forty feet deep, at the edge of the great ocean out beyond the islands? Suddenly I conceived of the plane of the ocean's surface as a barrier dividing us from another world, an immeasurable world of color, energy, movement, myriad life-forms, ageless, yet constantly changing, developing. What was below this barrier three million years ago? What will be there three million years hence? It came to me how the great astronomers were gradually pulling aside the veil which divides us from the infinite universe around us—"it's only 25 million-odd miles to the nearest planet, you know!"—and then I saw, even more clearly than before, the core of the purpose of the work of Dr. Beebe and his

staff, typical of the world-wide fraternity of scientific investigators—a fierce resolve to break through the barrier to this other dimly-known, living world, to observe it at its fringes and in its abysses, to analyze its infinite details, to sense its profounder depths. The Microscope and the Bathysphere!

After dusk a flood-light was submerged at the pier-end, creating a brilliant sub-surface area of light. Suddenly the night waters came to life as if by a signal, the tempo of activity reaching high and higher crescendos. Countless forms, gleaming and radiant, weaved before our eyes. By comparison, the whir of insects before an arc-light on an August night is dull and lifeless. Here was color as if expelled from tiny prisms, forms and sizes ranging from small rapid surface pilchards, herrings and anchovies to an occasional slow squirrel and snapper on the bay bottom below us. Twelve human eyes peering from shadow-streaked faces, the Director and John Tee-Van standing with nets ready to sweep for some specimen needed in the laboratory for further study—or even for the ever-hoped-for new species. The nets dipped—"Missed"—"Got him"—and so into the waiting aquarium.

The hot night passed. The morning was gray and windy, so our trip to the ocean was postponed. Instead, going to the laboratory at an early hour, I found the staff engaged in their own particular subjects of research. Each member had several different problems so arranged—having become so, automatically, throughout past seasons—that one of them could be carried on if the day were clear and calm, another if it were stormy and pouring rain, some needing brilliant sunshine, others only the electric beam from a microscope lamp, making work possible with sun, rain, daylight or darkness.

At the northeast end of the laboratory, Jocelyn Crane was immersed in the life histories of crabs¹ and those small but all-important insects-of-the-sea known as copepods. Not a single complete biography of any of these creatures is known, so the field is vast. Incidentally, in her outside time, she is completing a volume on Iraq, its present fauna and past history, inspired by a vacation spent several years ago in that neighbor of distant Persia. Her chief research at present is in collaborating with the Director in a series of

¹ Brachygnathous Crabs. Crane. *Zoologica*, Vol. 22, Part 1.

monographs on the deep-sea fish of Bermuda, and just now the weirdest of snipe-billed eels are being cross-examined to their very bones for facts for coming numbers of *Zoologica*².

Next, in point of laboratory geography, came the Director. A survey of his desk showed the diversity of interest which he blames on his two foster-fathers in science—Colonel Theodore Roosevelt and Professor Henry Fairfield Osborn. A casual note on a pad waiting for inclusion in a coming paper³ was that a golden eagle had just been seen six times in Castle Harbor, a wholly new bird to Bermuda. Several dishes filled with yellow liquid held twenty eggs of the giant deep-sea eel which formed the subject for the extraordinary motion pictures of development shown two years ago at the annual meeting of the Zoological Society⁴. These particular eggs are in-

² Nemichthyidae. Beebe and Crane. To be published in *Zoologica*, Vol. 22, Part 4.

³ Recent Notes on Bermuda Birds. Beebe. *Pro. Linnaean Soc.*, N. Y. 1937.

⁴ Development of Eel Eggs. Beebe. *Bulletin*, Vol. 39, No. 2.

tended for Dr. Frederick Tilney, who hopes for much of interest in a study of development of brain and nerves.

A nearly completed abyssal eel paper was awaiting a final survey, the cleared skull requiring a decision as to the presence or absence of a supra-occipital. At one side was the telephoned transcript of what the Director reported on his last under-water hike, and on a shelf a thick pile of fish data which he and John Tee-Van are compiling on rainy days, dealing with the *Zaca* collections made recently in the Gulf of California⁵.

John Tee-Van's desk appeared to be a junk shop as well as a perfectly appointed scientific laboratory table, for he is unfortunate enough to be mechanically minded, and to him falls the work of overseeing shipwrights, plumbers, carpenters, engineers and masons, whenever any part of the intricate mechanism of a deep-sea expedition weakens or cracks. To his photo-

⁵ The World's Greatest Fishing Grounds. Beebe. *Bulletin*, Vol. 39, No. 6.



The Laboratory at New Nonsuch, where the results of deep-sea work are analyzed. Here the staff is all assembled—Dr. Beebe, John Tee-Van, Jocelyn Crane, Gloria Hollister and George Swanson. Problems are so arranged that there is always work, whatever the weather may be.



Dr. Beebe provides the motive power for a cruise among the shallower reefs, walking on the bottom and pulling the boat.

graphic skill are due many of the motion pictures shown at the annual meetings of the Zoological Society. Besides the *Zaca* collection there is a definite and vital matter of three hundred-odd shore fish, whose life histories are waiting for the concentrated interest which Tee-Van devotes to them in his free time⁶.

Next, Gloria Hollister was surrounded by innumerable jars and glasses with attractive wine-colored contents. Although tempting in appearance, their imbibing would have certain Socratic results, for they consisted of various stains and clearing

⁶ Systematic Notes on Bermuda and West Indian Tunas. Beebe and Tee-Van *Zoologica*, Vol. 21, Part 3.

solutions. Miss Hollister is X-Ray Extraordinary to herself and all, preparing the delicate transparent specimens which are so valuable in this fish work⁷. Her own monographs deal with the evolution of the tail bones of various groups⁸, and she also works magic on deep-sea fish whenever necessary. In the boat-house near the wharf are the aquaria where at the present time a half-dozen sargassum fish, under her care, are growing visibly upon a monstrous diet of guppies and any incautious brethren which they can reach.

George Swanson, artist, labored at the far end of the laboratory room, half-smothered in countless sketches and finished drawings of eels, fish tails, any rare creature of brief life but extensive beauty which comes to the laboratory.

A further experience remained for me on this day. Responding to a call of "all set" from John Tee-Van at the water-edge below the laboratory, we went down to the wharf. The diving helmet, with telephone attachments, was placed on Dr. Beebe's shoulders. Tee-Van, I and the native boatman got in a row-boat, the latter at the stern pumping air, and in a moment we were headed

⁷ Fish Magic. Hollister. *Zoologica*, Vol. 12, No. 10.

⁸ Caudal Skeleton of *Percesoces*. Hollister. *Zoologica*, Vol. 22, Part 3.



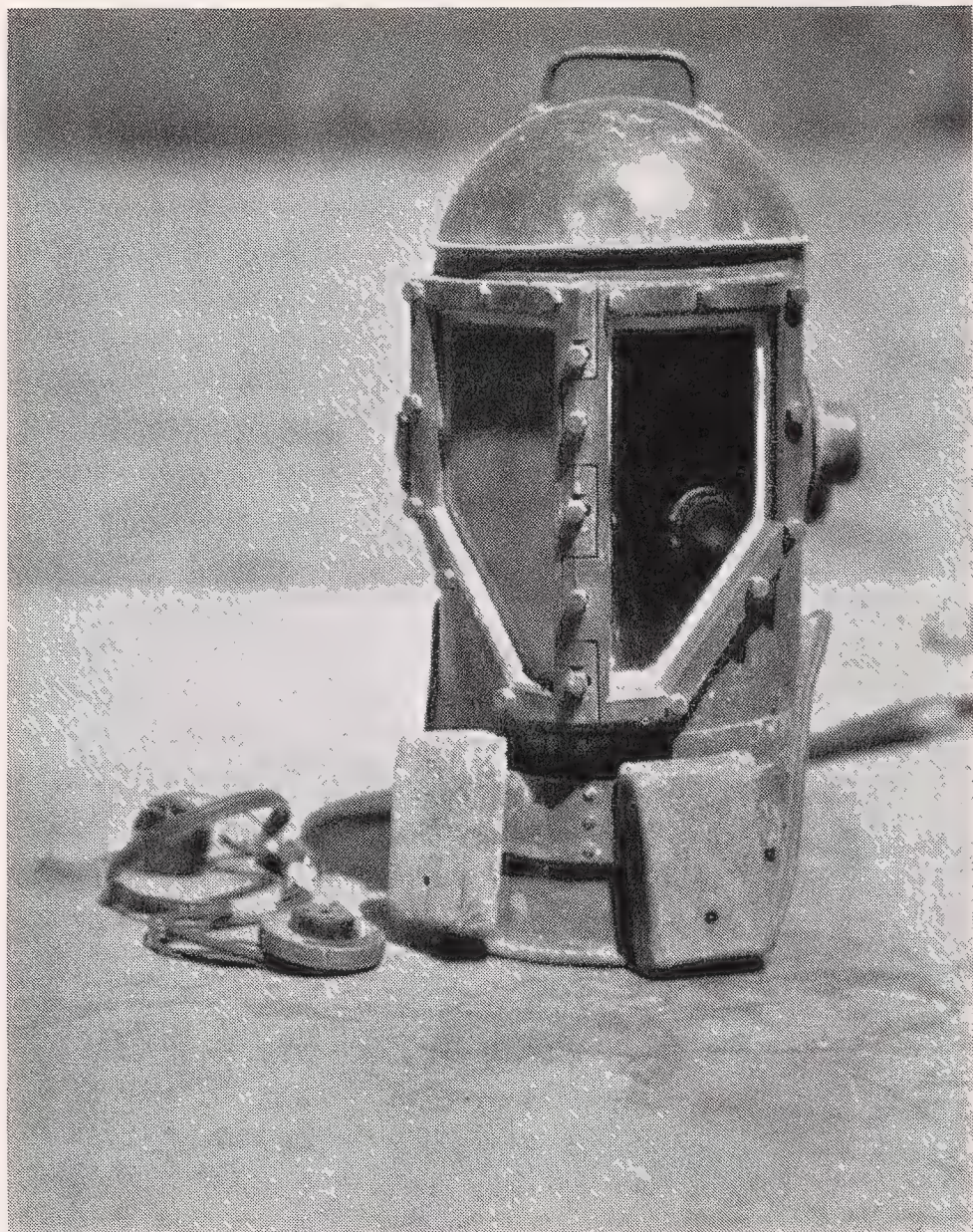
A telephone attached to the diving helmet enables the person under water to send up a running report of his observations to the boat, where it is taken down in shorthand for use later.

out into the bay. Our motive power was the Director himself, walking ahead of us on the bottom in about fifteen feet of water, pulling us along by the painter rope. Adjusting my earphones a muffled voice came back to me. "Bottom sloping, covered with mermaids' paint brushes and red sponges—school of gray snappers rushing past—sun jelly overhead—many urchins decorated with shells—passing old wreck covered with tunicates and hydroids," and so on. Then—"How's my direction?" and Tee-Van, on the other phone extension, called back "A little more to the east." I remembered now seeing a small wind-shield compass installed on the inside face of the helmet. We headed then toward a small promontory, the voice of our pilot continuing to report back "news items," and finally, reaching shallow water, the helmet-top emerged, bubbles in its wake, and we came alongside our "engine" and pulled him into the boat.

"We can cover a lot of ground in our observation work by this method," Dr. Beebe remarked. "The earphone set you had on is usually used by one of the staff who can take shorthand notes. I want if possible to survey all this sea floor this side of the outer islands, and, you see, in this way we can cover a lot of distance and save a lot of time." Time—always, still, the contest between the days and the millions of years!

My third and final day dawned in serene beauty, the water flecked by the daintiest of breezes, the sky a brilliant blue curtained by cumulus clouds at the horizon. Aboard the launch *Skink* we were soon out beyond the islands near a reef at the very ocean's edge. "Your time here is limited," the Director remarked, "so your diving education will have to skip the high-school and college courses and we'll plunge right into post-graduate work." Plunge indeed! Suddenly I felt friendless. Was that a quizzical, slightly challenging look I saw in their eyes? Anchors went over bow and stern, followed by what appeared to me endless lengths of rope till the anchors caught bottom! Was I to go down into that dark other world? A ladder, of light chain, with metal rungs, was payed out over the side—out, out, out—finally reaching bottom.

"I'll go down first," the Director said. A metal helmet, mediaeval looking, glass-fronted (sixty pounds of weight) was placed over his shoulders.



This helmet, which rests easily on the shoulders, is used for walking among the reefs. A compass is attached to the glass face.

He looked tiny beneath it, and disappeared. The native boatman pumped, bubbles spoke at the ladder-top and then went seaward. He was at the bottom and walking away on the ocean floor, forty feet below, visible dimly through the water-glass.

Ten minutes later I found myself where he had been—fear gone, depth pressure on ears forgotten, strange noises of air escaping from helmet unheeded—standing, awed, in a new world. Around me, over me, enveloping me was the rhythm of the ocean, yes, the world's oceans—a flowered world, sun-lit even here, gardens of sea flora, vari-colored, waving ceaselessly before me. A reef loomed fifteen feet above me, fronds, plant and animal tentacles extending from its wall in front of me, and gradually, just as in the heavens of the early evening, star after star comes to one's view, the moving forms of the life of the sea appeared before my eyes, singly, small schools, large schools, fish everywhere about me, color-dashed—blue, yellow, golden, gray, scarlet. Several times a sergeant major or a blue-head wrasse or a company of green and yellow parrots, or a yard-long cornetfish, would swim

rapidly towards me, peer inquisitively through the glass front of the helmet directly at me and then turn away with a "Beg-pardon—thought-you-were-a-friend-of-mine" flip of its tail. But such near-intimacies were but brief interludes. I had a sense of being an intruder in this brilliant living, moving world. The strange sub-aqueous diffused light, like early dawn, the moving forms, now clear, now dim, aroused sensations totally unconnected with those of the earth-world.

The helmet, lead weighted, kept one's feet in contact with the ocean floor. A spring forward would result in a slow parabolic curve, upward then slowly down to foot-touch again.

I walked forward along the edge of the steep wall of the reef, which towered above me, its upper edges and further distances resolving dimly in the underwater light, giving an unreal impression of its height and length. It mattered little whether I walked forward or stood still—in either case the life of the sea was before my eyes, either in the motion of many fishes swimming here and there or in the rhythmic motion of sea-plants. I was about to move forward, responding to the innate exploratory impulse which is within all of us, the feeling "I wonder what is over that next hill?", when I became vaguely aware that the inside of the glass was becoming misty. Although I had been told just before descending that when the vapor of my breath dimmed the glass I should bend forward and let

the sea-water wash into the interior of the helmet, thus clearing the glass, somehow, apprehensively, I did not relish trying it at that depth. Turning, with an impulse of fear sweeping through me that I should not be able to find the ladder before visibility was cut off, I walked back along the reef's wall. Where was that ladder—my only means of returning to air and sunlight? For an instant the ocean seemed oppressive, heavy—I was cut off—alone, desperately looking. Suddenly, opaquely, the ladder appeared before me. I felt a sharp sense of relief, and clambered slowly, up and up, to the surface. Dr. Beebe, John Tee-Van, Miss Crane stood smiling before me, a query on their faces implying: "What will he say about his first dive?" I said nothing. I had seen a miracle and lived, in that short space, through an undreamed-of experience. Language wasn't designed for such moments!

That evening, having dined with my brother and his family, and returning at a late hour to the Biological Station where we had had our sleeping quarters, I found Dr. Beebe waiting up for me. A large binocular in hand, he led me to an upper terrace. "You must see the newly-discovered Finsler's comet. It's in superb display tonight." Peering, there glowed before one's eyes a heavenly, radiant new world. A few minutes later, the ocean rhythm, the comet's flight, melding into a symphony within me—I fell asleep.



The author emerges from his first walk on the ocean floor.

An Artist on the Sea Floor

Among Bermuda's Reefs the Brightly Colored Fishes Swim in "a Cool Quiet Room Lit by Green Glass"

ROBERT GIBBINGS

MY interest in fish began on the day when I first looked into a South Sea lagoon. The impression was as staggering to me as the first sight of an orchid house interior might be to an Eskimo. The various forms that I saw in the water were as strange and their colours as vivid as anything by which the most ardent horticulturist could hope to flabbergast a guest from the Arctic.

I had journeyed to the Pacific prepared to see a luxuriance of tropical blossoms. I expected to find hedges of hibiscus and avenues of frangipanni. I knew that there would be native feasts and moonlit dances and no lack of incident among the islands, but from the moment that I borrowed a canoe and floated over those coral gardens with their multi-coloured inhabitants I knew that henceforth it was farewell to excitements on shore or adventures in the deeper waters beyond the reef. Here in every cubic yard was material for a life time's study.

Of course I knew absolutely nothing about these fish except that they were beautiful. They seemed more gorgeous than anything I had ever seen in my life; their shapes, their markings and their colours. Every morning while the surface of the lagoon was still unruffled, every evening when the trade wind had died down I spent hours drifting in the canoe watching with amazement this underwater panorama.

But I soon realized that the inhabitants of the reef received any shadow overhead with suspicion and that I was missing a great many of the shyer individuals. I used therefore to approach them on more equal terms by immersing myself to the chin and remaining as motionless as possible. After a few moments they would

begin to appear and, eventually crowding round me, would pick at the fragments of coconut which I chewed and spat into the water for them.

Then I made friends with a fellow countryman of mine called Carney. He had a Japanese friend called Kono and a Chinese maid of all work called Kitchee. Kono and Carney would go fishing at night and in the morning Kitchee would bring me any specimens whose bright colours suggested that they might be poisonous. Warning colouration certainly served its purpose in those cases, for the fish were brought to me alive and when I had completed my drawings I let them go again in the lagoon outside my door.

It was through Carney that I first became acquainted with the Surgeon-fish who carries a lancet at the base of his tail, with the Coffer-fish whose skeleton is mostly soft cartilage and who is held together by his box-like exterior, and with the Vache-de-mer who with his horns and large eyes strangely resembles a cow.

Kitchee brought them to me in an old enamelled basin; she brought them faster than I could draw them and many an hour I spent in trying to record their features.

One day Norman Hall, of *Bounty* fame, suggested that I should go with him to Tetioroa, a low coral island about twenty miles north of Tahiti. It took us several days to persuade the crew of the schooner to leave the cinema at Papeete but eventually we woke early one morning to see a long low line of palms on the horizon, and a couple of hours later we were in the surf boat heading for the reef.

A group of islanders had waded across the lagoon to meet us and but for them we should

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certainly have met destruction, for the wave did not carry us quite over the reef and for a moment we remained suspended between sky and sea, balanced precariously on the wrong side of a bristling reef. Fortunately a rope had been thrown and seized and held and thus were our ambitions saved from extinction and our children rescued from orphanage. The next mountain of water carried us to safety and we were towed in state to the shore.

Tetioroa, atoll of five islets, what do I remember of it? Palm trees, of course, and a thick fern-like scrub growing everywhere. Not a spot of land more than a few feet above sea level. There was a white tern that flew threateningly at our heads but never came quite close enough to be hit. There were mosquitoes at night and flies in the daytime, surely the most persistent flies God ever made. Over and above all other memories and impressions there were fish.

This happened several years ago but it always remained my firm intention to get back to the reefs. At last, in the middle of July, 1937, I reached the Biological Research Station at Bermuda. There I found a launch, a diving helmet and an assistant; it only remained for me to get into the water and draw.

Before leaving England I had discussed the possibility of underwater drawing with my colleague Cyril Pearce at Reading University and he, after various experiments, put up the idea that I should work on sheets of prepared zylonite. This highly polished material, somewhat resembling celluloid, can be rubbed down with sand paper to a smooth matt finish so that the surface takes pencil as clearly and pleasantly as any paper. By using pencils of thick graphite, without wood but slipped inside rubber tubing to avoid soiling the hands, there was nothing in the apparatus which could be damaged by water.

My first dive was not a success. The sea was rough, the water was cloudy, and there was a strong current running. In spite of sixty pounds of lead on my back and chest I could not keep my feet on the ground. My toes just touched the bottom as I hung suspended, light as gossamer, making no impression on the sea floor. This was flattering to my normal two hundred and fifty pounds, but it wasn't practical. Half

swimming, half scrambling I reached the upper air and explained my difficulty, whereupon my resourceful companion produced twenty pounds of lead piping which he modelled into a girdle for my hips. We arranged this so that in case of emergency the two ends could be pulled apart and the whole thing dropped at a moment's notice, but I am glad to remember that the necessity for such action never arose.

Having perfected the balance, we turned our attention to the materials, and devised a drawing board backed with sheet lead so that at a depth of fifteen to twenty feet, it had little or no weight. To the front of this we pinned the zylonite, to one corner we attached the pencil by a yard of cord, and to another corner we fastened twenty yards of line. From then on it was easy going. Having selected a spot for diving, and gone over the side, the drawing board was dropped overboard by my assistant, and easily retrieved by me on the bottom. When the drawing was finished it was hauled up by the long cord, of which one end was fixed in the launch, and I followed rather more slowly by the rope ladder.

My impression of this underwater world was as of being in a cool quiet room lit by green glass. The intense silence reminded me of a broadcasting studio. Other divers have described their feelings of solitude when below the surface but I felt none of that. I seemed merely to have achieved a great freedom; the water was much too thickly populated to allow any sense of loneliness. There were, of course, disturbing factors at first, such as the noise of the air from the inlet pipe, and the pressure on one's ears, but at each subsequent dive there was less and less consciousness of these troubles so that in time they ceased to be noticed. I found it difficult also to judge distance and many a time my hands and feet fell impotently short of their mark.

But it was perfectly easy to draw. I could not make elegant sweeping lines, but it was possible to make notes of sufficient accuracy to be worked on afterwards. One thing in particular struck me, namely the apparent size of any object in proportion to its importance to me. In the upper world of air we have accustomed ourselves to make subconscious adjustments in our vision so that an elephant seen a mile away

still conjures up an idea of something large though in actual dimensions on our retina it may be no bigger than that of the mosquito on our boot. Under the water all accepted rules of perspective vanished: if a particularly interesting small fish passed in the distance I found that in my drawing he was depicted as very much larger than something in dull colours, ten times his size, which happened to be close by.

mitted light; for instance a blue and purple Parrot-fish which I kept in one of the Station aquariums was blue and purple only when viewed from outside, when looked at from inside the laboratory, with the light behind it, the purple showed as its own complementary colour, yellow.

In considering the conspicuous patterns as camouflage for their owners, one has to remem-

The drawings on the four following pages are reproductions of some of the actual sketches made by the author at Bermuda, on a metal drawing board, under fifteen to twenty feet of water. They are necessarily rough sketches, to be supplemented by many detailed drawings of fish, coral, anemones and other striking forms of under-water life, in preparation for a monumental series of engravings.

This seemed a parallel to primitive art where objects were drawn on cave wall or canvas, according to their importance to the artist, and not according to mathematics and laws of optics. Doubtless, when I have dived more often, I shall begin those cursed adjustments of reason and may even, in time, write a text-book on the subject. God forbid!

The fish crowded round, dozens and dozens of them, hundreds in fact. There were Blue Angels and Sergeant Majors, Trigger-fish and Grunts, Demoiselles, Four Eyes, and Porgies. The Angels came and looked through the window of my helmet, the Porgies and Slippery Dicks swam between my legs and the Sergeant Majors nibbled at my shoulders. I often had to wave my arms to drive away these insistent seekers after food and knowledge. In and out, through the swaying branches of the soft coral, under the overhanging brain stones and from behind the purple fans they came and went, moving without apparent effort, while the blue and gold clumps of iridescent weed swayed with them in the ocean swell. It was a ballet designed by "The Great Artist" himself and every performer was a star.

One of the most surprising things about these fish is their power to change colour. It is indeed almost impossible to attribute any particular colouring to certain species, for they can vary it almost instantaneously and a blue fish coming to rest over brown weed is brown in a few moments, a sparkling silver fish passing from sand to rock takes on a dark and even muddy hue to match its new surroundings. Many varieties show differently when seen in reflected or trans-

ber that the light under water is probably never unbroken. Owing to the ripples on the surface, even on the calmest day, the light that filters through has to some extent the flickering quality of sun shining through the branches of wind-swept trees; furthermore the scales of a fish are capable of a high degree of reflection and many a black band on a fish can show as a bright reflected light. It may not be unreasonable to suppose that when a fish is going at high speed from his enemy, the propulsive undulations of its body cause the dark and light bands to cancel out so that the fish would become almost invisible.

How does it all compare with Tahiti?—Not very well. In the South Pacific, nearer to the equator, the coral grows more vigorously and the fish are more exuberant in their forms and colours. For every brightly coloured variety in Bermuda you will find a dozen among the atolls of the south, for every individual in the Atlantic you will meet a hundred in the Pacific. In Bermuda the soft branching *Gorgonia* corals flourish exceedingly and the brain stones rear themselves one on the other in elemental forms, but the great buttresses of living rock, richly sculptured as an Indian temple, are absent. In Bermuda one meets individual fish of great beauty but among the reefs of Tahiti, Moorea and Tetioroa you will find shoals of them, not in tens, twenties, or fifties, but in hundreds and I believe it to be without exaggeration to say sometimes in thousands. One day I'm going back to the native house on the edge of the lagoon called by the natives of Tahiti "The house that waits for Robert."









Fresh Water Jelly-fish at the Aquarium

New Notes on Their American Distribution Raise Some Questions as to Their Apparently Increasing Abundance

C. M. BREDER, JR.

JELLY-FISH are ordinarily considered marine creatures, and so they are except for a tiny percentage of the group that is found in fresh water. So uncommon is the occurrence of these that usually their appearance prompts the finder to record the event in some biological journal. The present note is a continuation of that policy, as well as the recording of a favorable circumstance that made it possible for the New York Aquarium to exhibit some for the benefit of the general public.

The few kinds of jelly-fish that inhabit fresh waters are widely distributed. There is one species each from Africa¹, China², India³, perhaps two from Europe⁴, and one from America⁵. Although only the American species is the subject of this account, it may be mentioned that none of the others is common where found, nor can they be relied upon to put in a regular seasonal appearance.

The physical appearance of these American fresh water medusae is well illustrated in the accompanying photograph. Because of their delicacy and fragility, they must be handled with great care for aquarium purposes. These specimens are about the size of a dime. Varying from transparent to opalescent, they are exceedingly attractive as they make their somewhat zigzag course through the open water of their aquaria. They are easily stimulated to energetic movement by a bright light, and irrespective of its point of origin, seem to be impelled by it to seek the surface.

The life history of these forms is a rather

complicated affair, as is common to most jelly-fishes. They develop from a very inconspicuous attached hydroid into a tiny free-swimming jelly-fish with but eight tentacles, and these were formerly supposed to be a distinct species, *Microhydra ryderi* Potts, but are now known to be only a developmental stage. The adult, sexually mature medusa little resembles the juvenile form. It is the mature animal that is here illustrated and which we have had on exhibition. Indeed, the immature forms are not suitable for exhibition in public aquaria because of their exceedingly small size. After adulthood is reached, reproduction takes place, the cycle is complete and the medusae die. For this reason they cannot be a permanent aquarium display.

The picture here shown is of specimens from an outbreak in the water supply of Birmingham, Alabama. They were a source of worry to the Birmingham Water Works Company during late July and early August of 1933. There was another outbreak at the same place during 1935 at the same time of year. Their highly seasonal nature, coupled with their extreme delicacy, should prevent them from ever being a serious problem to water works engineers. It is consequently noteworthy that these specimens nevertheless were transported to New York where they lived for some time. This occurrence represents a record from a new locality in Alabama, as they were hitherto known only from Tuscaloosa in that state.

The specimens which were exhibited this year were brought to the Aquarium by Mr. Warren Condit, who collected them in Brady's Pond on Staten Island, New York, and who is continuing field studies on their appearance and disappearance.

¹ *Limnocnida tanganjicae* Günther, 1893.

² *Craspedicuspa kawaii* Oka, 1908.

³ *Limnocnida indica* Annandale, 1912.

⁴ *Craspedicuspa sowerbii* Lankester, 1880, and *Microhydra germanica* Roth, 1924.

⁵ *Craspedicuspa ryderi* (Potts), 1885.



These are living, mature specimens of the fresh-water jelly-fish in their various swimming attitudes. The photograph was made from specimens that were on exhibition at the Aquarium, and are a trifle more than life size.

This locality is remarkable in that they were first found in 1933 and have been found there every year since, this making the fifth successive season. Mr. W. T. Davis, a veteran naturalist of that region, first reported on this apparently persistent colony. The place of publica-

tion of this record is given in the accompanying list of occurrences, together with the other American records arranged in chronological order according to publication dates. In fact, one of the peculiar features of these organisms is that usually they are found but once in any one

locality. A consideration of the list of localities makes this clear and is one of the difficulties in the way of any study of these forms.

Since exhibiting these specimens from Staten Island at the Aquarium, Mr. Davis reported that specimens of this jelly-fish were found in Cranberry Lake, Sussex County, New Jersey, on August 29, 1937, by Miss Jane De Puy, with authorization to record them here. This adds a new state in which they have been found, the record now standing as twelve states, the District of Columbia and the Panama Canal Zone. In the tabulation heavy-faced type is used for the first record from each state or its geographic equivalent.

Through the kindness of Dr. N. Mullendore of Franklin College, Franklin, Indiana, it is possible to add the following to the Indiana localities already known. Dr. Mullendore released her record with these remarks: "Fishermen found the first medusae in an old gravel pit about seven miles east of Franklin, near Sugar Creek, in late September, 1931. Subsequent investigation revealed the presence of scores of medusae which were very active during early afternoon when the sun was shining and the water was calm. The medusae rose from the depths of the pool by contractions of the velum, the exumbrellar side being uppermost. When they neared the surface, the animals turned over and with the subumbrellar side uppermost they descended.

"Several trips were made to the gravel pit and the organisms were found on warm days during October. A number of medusae were collected and brought to the biology laboratory of Franklin College where they lived for several days in aquaria.

"The following year medusae were found again. No hydroids were ever found. The pool is approximately 100 feet by 300 feet in surface extent, and is fairly deep, sloping abruptly from the shore line, so that investigation of the floor was considered too difficult. At that time there was no connection between the water of the gravel pit and that of the creek, but floods cause the waters to mingle.

"Brief and infrequent visits to the pool in 1936 and 1937 have not been rewarded by the appearance of any medusae."

The condition of the environment, the behavior of the medusae and the other remarks

are in keeping with the generality of other similar descriptions.

The distribution of records is shown in the accompanying outline map. The spots record a single occurrence except as indicated in the tabulation of data. A single spot covers the Staten Island records of Davis (1937) and the New York Aquarium spontaneous occurrence record of Breder (1928).

An attempt to interpret this distribution leads to little that could throw light on the life and nature of these generally evanescent creatures. They seem to keep out of the Alleghany Mountains and consequently may be rated as a lowland form occupying the coastal plain and the Mississippi drainage with these two bands of occurrences connected across the lowlands of Alabama. This type of distribution is not uncommon to a variety of other aquatic animals.

Of the region in which these animals are known at all, probably the environs of New York City, Philadelphia, and Washington have been most fully combed by field naturalists simply because there have been more resident in those regions, continuously, for longer periods than elsewhere. Nevertheless, the record of finds is not nearly proportional to those of the less frequented localities, as the following indicates.

New York region:

1928 New York Aquarium tanks.

1933-1937 Staten Island.

1937 Cranberry Lake, N. J.

Philadelphia region:

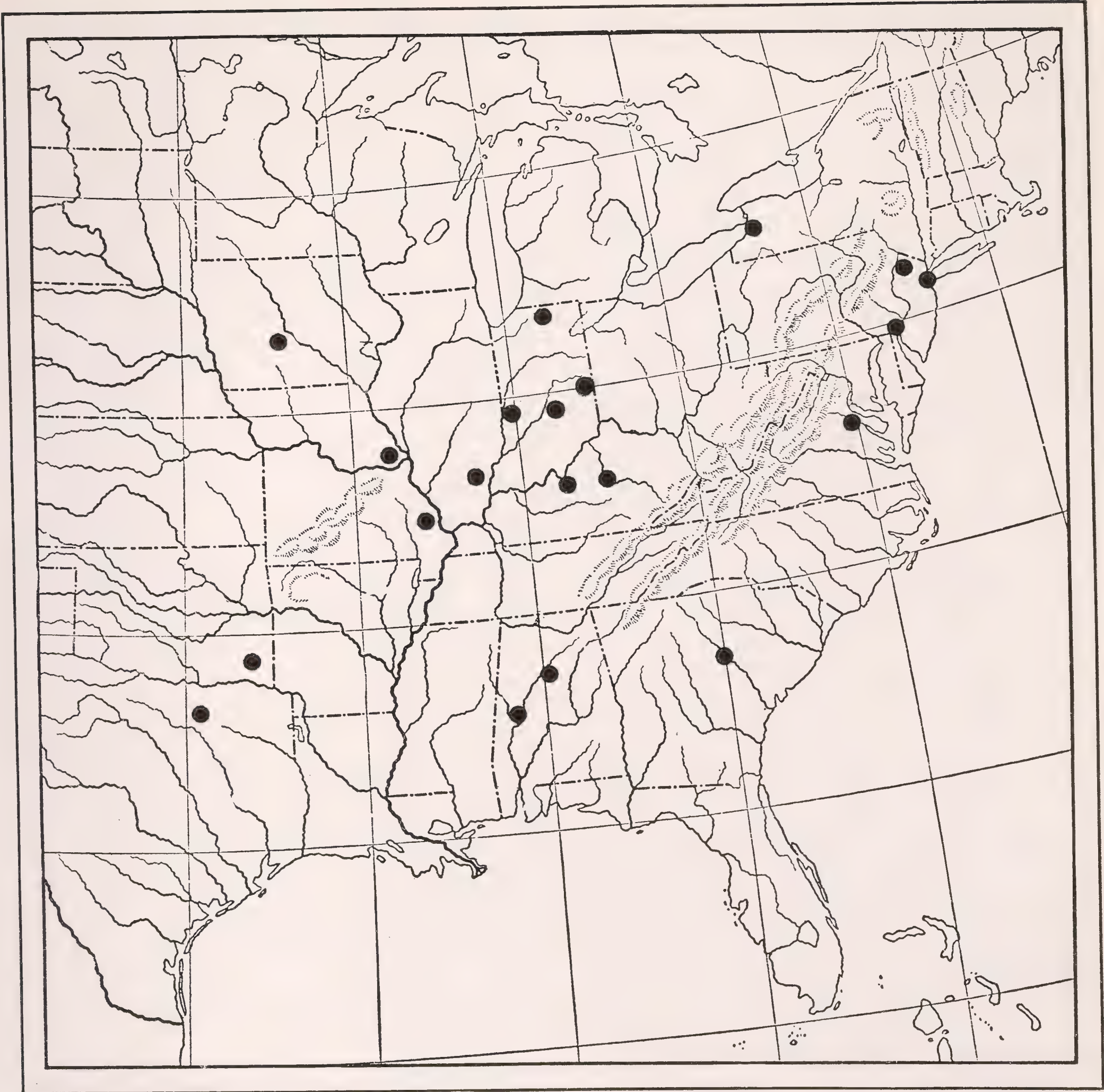
1885 and 1897 "near Phila."

Washington region:

1907 Shaw's Lily Pond.

1927 Potomac River.

On the other hand, such relatively less-known areas as Kentucky have produced five records. Since they were found near Philadelphia in 1885 and 1897 (hydroids and medusae), why have none been reported since? Certainly field naturalists have been active thereabouts in these last fifty-two years. It would seem that some of these gaps represent true absences of at least the medusae. Probably only a better understanding of the physiology, environmental needs and general habits could give the true explanation of the apparent erratic nature of these animals.



American records of *Craspediscuspa ryderi*. Each spot indicates one or more records listed on the following page. A single additional record, not shown here, is for Gatun Lake, Canal Zone.

A consideration of the distribution of the records in time seems to suggest that the relative abundance of these fresh water cousins of a great marine group may actually be on the increase. If the list of records be split in two parts of twenty-six years each, the first one contains only two different localities. This drift toward more numerous records is even more marked if the fifty-two-year period is divided into four parts of thirteen years each. This data may be tabulated as follows.

<i>Period covered</i>	<i>Localities reported</i>
1885 to 1898	1
1898 to 1911	1
1911 to 1924	3
1924 to 1937	9

It might be argued that these differences may have to do with the activity of field naturalists. Although it would be difficult to establish clearly, the writer does not think that this has much, if anything, to do with increase in number of records. During the first two periods there was

much field activity of a purely descriptive nature. The "old-time" field naturalist was still very much in evidence and with the broad interests of that group, little of interest of macroscopic proportions escaped finding its way into the printed record. In the latter two periods there has been a tremendous drift toward laboratory study and specialization in field work. This in itself should tend to reduce such records instead of increasing them manifold. It will be interesting to see what future years may bring forth in regard to the occurrences of these jellyfish.

The distribution in time as compared with

the geographic distribution was studied to ascertain if there might be any drift or invasion of the species over the region covered. Nothing of the nature could be found, the occurrences in time having no apparent reference to place.

If it is true that these things are becoming more numerous, and not just apparently so because of some obscure trick of too limited statistics, one wonders just what would be likely to be responsible for the condition. The records tie in with no known environmental change. Here again is another problem in the strange comings and goings of these little-understood invertebrates.

AMERICAN RECORDS OF *Craspediscus*.

Dates refer to publication, not time of finding.

- | | |
|---|---|
| 1885. Pennsylvania. Near Phila. Potts. <i>Science</i> 5(123):4. | 1932. Missouri. St. Charles. Bennett. <i>Amer. Nat.</i> 66:287-288. |
| 1897. Pennsylvania. Near Phila. Potts. <i>Amer. Nat.</i> , 31:1032-35. | 1932. Indiana. Near Richmond. Garner & Markle. <i>Proc. Ind. Acad. Sci.</i> 41; 431-432. |
| 1907. District of Columbia. Shaw's Lily Pond. Hargitt. <i>Science</i> , 26:638-9. | 1933. Indiana. Near Terre Haute. Allyn & Rettger. <i>Proc. Ind. Acad. Sci.</i> 42: 259-260. |
| 1916. Kentucky. Near Frankfort. Garman. <i>Science</i> 44:858-60. | 1934. New York. Near Buffalo. Robertson. <i>Hobbies</i> 15:11-12. |
| 1924. Kentucky. Near Frankfort. Garman. <i>Science</i> 60:477-78. | 1934. New York. Near Buffalo. Robertson <i>Science</i> 80:403. |
| 1924. Indiana. Elkhart. Payne <i>Journ. Morph.</i> 38:387-430. | 1934. Texas. Near Dallas. Cheatum. <i>Science</i> 80:528. |
| 1924. Georgia. Augusta. Payne. <i>Ibid.</i> | 1936. Illinois. Near Carmi. Van Cleeve. <i>Science</i> 83:443. |
| 1925. Panama. Gatun Lake, C. Z. Smith. <i>Science</i> 61:588-589. | 1936. Iowa. Near Des Moines. Aitken. <i>Science</i> 83:186. |
| 1925. Kentucky. Near Frankfort. Payne. <i>Science</i> 62:421. | 1937. New York. Staten Island. Davis. <i>Proc. Stat. I. Inst.</i> 8:15-16 and 43-44. |
| 1926. Kentucky. Kentucky River, 4 places. Payne. <i>Bio. Bull.</i> 50:433-443. | 1937. New York. Staten Island. Davis. <i>Bull. Stat. I. Inst.</i> 20(2):4. |
| 1927. District of Columbia. Potomac River. Schmitt. <i>Science</i> 66:591-593. | 1937. Missouri. Near Fredericktown. Atwood and Steyermark. <i>Amer. Nat.</i> 71:280. |
| 1927. Kentucky. Near Owensboro. Schmitt. <i>Ibid.</i> | 1937. Alabama. Near Birmingham. See text. |
| 1928. New York. N. Y. Aquarium tanks. Breder. <i>Science</i> 67:242. | 1937. New York. Staten Island. See text. |
| 1930. Alabama. Tuscaloosa. White. <i>Bio. Bull.</i> 59:222-232. | 1937. New Jersey. Cranberry Lake, Sussex Co. See text. |
| 1931. Oklahoma. Near Broken Bow. Ortenberger and Phillips. <i>Science</i> 74:222. | 1937. Indiana. Near Franklin. See text. |

A Tropical Holiday

The Curator of Mammals and Reptiles Visits the Panama Canal Zone
Where Jungle Life Is Coming Back Around Madden Dam

RAYMOND L. DITMARS

RETURNING from a trip to Panama, I have much to think about and anticipate in the coming year. The journey south was made on the S.S. *Colombia* of the Colombian Line and northward on the *Haiti* of the same line. Primarily the trip was a vacation, but I was scheduled to give a lecture on the habits of the vampire bat before the Panama Canal Zone Natural History Society. The lecture was to be illustrated by motion pictures prepared under various difficulties through considerable time.

It was Dr. Herbert C. Clark, Director of the Gorgas Memorial Laboratory at Panama, who started me on the vampire work. My part of it was no more than a follow-up on the brilliant research of Clark and Dunn, who first suspected, then proved, that vampires in search of their blood meals indiscriminately bit infected but resistant cattle, then horses that were not resistant, which resulted in the death of the latter.

The pathogenic organism concerned, a trypanosome, multiplied in the blood stream. From location of the source of equine trypanosomiasis, their work went on to vampire control and protective treatment of horses. What had interested me particularly was that they were able to keep vampire bats by feeding them defibrinated blood.

Making a short trip up the Chagres Valley to the Chillibrillo Caves in company with Arthur Greenhall of the University of Michigan, in 1933, we obtained a vampire and brought it back to New York. I was astonished to see the acclaim the bat produced, but it happened to be the first vampire ever to be publicly exhibited.

Dr. Clark suggested that I make a study of the longevity and feeding habits of this species of bat and ultimately my collection of vampires increased to six, four being collected during a later trip to the island of Trinidad. Through slow and cautious work in introducing them to stronger and stronger lights, their actions were recorded on motion picture film, bringing out unrecorded habits. The bats stalked about like big spiders, leaped straight upward from the ground to fly, lapped blood from a dish with darting tongue; in fact, displayed actions quite different from the formerly alleged habits of vampires.

This was the motion picture material which illustrated my lecture at Panama. One of the bats concerned had been in captivity for three years and the others for two years. Through all this period I had never been able to induce them to take anything but blood meals, although all kinds of what might seem to be small prey in addition to actual blood meals was offered.

Arriving in Panama, I checked these observations with those of Dr. Clark and his observations agreed with my findings. I found that he had built up his collection of vampires to thirty specimens, each kept in a separate cage, and that two of his vampires had lived for five years. From this extensive series his research had brought out another important point. It had been indicated that bats picking up trypanosomes from infected cattle, became victims and died of the organisms a short time later—but not until they had had an opportunity of infecting equine stock. Now it seems that some vampires survive as carriers for a number of months. Dr. Clark and I conferred over these points and the introduction of the

lecture was a composite picture of his work and mine.

After several days in and out of the Gorgas Memorial Laboratory, I journeyed up the Chagres Valley to visit the Madden Dam, a marvelous project recently completed to control the water of the Chagres River, which is the principal feeder of Gatun Lake, hence of high importance in the operation of the Panama Canal. In past years, during the rainy season the river had flooded and rushed down too much water. Again, during the dry season there had not been enough. The great dam, which at times when the gates are open resembles the spectacle of Niagara, now controls the situation. It has formed a reservoir more than twenty miles long, and incidentally runs a powerful hydroelectric plant. To take the small Government launch along the shores of this great water storage is a revelation to a naturalist, as it enables him to prowl among islands covered with virgin forest.

My trip to the dam was made with keen interest to see how the jungle was coming back over the large quadrangle which had formerly been the encampment of the engineers. All of the cabins, except in the immediate vicinity of the dam, have been abandoned and dismantled. A thick tangle of growth is creeping over the area. I spent two successive summers with the engineers when the dam was being built and then we had to walk several miles back into the jungle before seeing much of the wild life. The reverberations of dynamite and sounds of machinery on the vast project had driven the animals away. But now, I was told, the chorus of troops of the big howling monkeys is heard close to the dam. I heard none during my two summers there. Also, marmosets are to be seen in the immediate area of the place, as well as parrots and macaws.

The road to Madden Dam, which starts near the Pedro Miguel locks, is ideal for a day's tropical adventure—and a revelation. It is Government-built, of two-ply cement, and kept in perfect condition. It leads through tropical forest as dense, luxuriant and impressive as is to be found anywhere in hot countries. Along each side is a grass strip kept as meticulously trimmed as along a parkway, yet to stop one's car and walk a few feet is to stand in a back-

ground as botanically wild and virgin as if the observer were hundreds of miles in the remote and unmapped interior.

Also there is the thought of the animal life that inhabits the region and is nearby—monkeys, jaguars, pumas, ocelots, big tree weasels, handsome birds and interesting reptiles, large and small. Boas and bushmasters cross this road. One may drive it a dozen times and see nothing, but there is always the thought that the life is nearby, keeping a wary lookout as the car rolls smoothly through a fascinating scenic lane.

It is largely from this area that Dr. Clark obtains his bushmasters. He is investigating the character of the venom with a view to producing a specific antivenomous serum. It was a dramatic spectacle to me to see four of the big crotalids in a pen in his laboratory—particularly when I remembered past bushmaster hunts in Panama, the reptiles always evading me. The doctor is carrying on intensive study of the incidence of all kinds of snakes inhabiting Panama and has collectors in various areas. Most of the snakes are killed before they are sent in, but this does not prevent identification and tabulating. A list given me, and covering 1937 up to September 18, showed a total catch of 1,191 snakes, of which 400 were poisonous—approximately 33 per cent. The commonest poisonous reptile is the little hog-nosed viper found in the upper, drier areas. Of these there were 186. The next most abundant is the fer-de-lance, of which there were 121, some of the specimens in excess of six feet in length. There were 75 coral snakes, 14 bushmasters, 3 horned palm vipers and 1 sea snake, the latter taken on the Pacific side. Poisonous sea snakes do not occur on the Atlantic side of the isthmus.

Before leaving for the Atlantic side, I visited the serpentarium and exhibit of mammals and birds of Panama maintained by Douglas March near the ruins of the old city of Panama. This is a thoroughly worth-while visit. The collection is very interesting and attractive and well maintained. The variety of animals and the bright colors of the birds show how rich the fauna of the region really is. It is a lesson in what exists in the forests passed through on the way to Madden Dam. Then again, the area in which March presides over his collection is

of great historic interest, and March, who is a thorough student, can explain much about it. Low jungle grows over much of the area from which the ruins of churches and heavy structures rear, draped with vines, with small trees springing from crevices high overhead. The place is steeped in legends and stories of alleged treasure buried when the city was burned on the arrival of Morgan's fleet. Some of March's most interesting specimens were trapped in the immediate vicinity.

While on the Pacific side, James Zetek, Curator of the Institute for Research in Tropical America, on Barro Colorado Island, was most kind, as always, but time was insufficient to visit the island as in past years.

We returned to the Atlantic through the Canal on the British steamer *Mataroa*, nineteen days out of New Zealand, boarding her from a Government launch while she was moving, as the vessel did not dock at Balboa.

On the way northward the Colombian liner made two points in Haiti, one at Cap Haitien with ample time to make an ascent by mountain mules and horses to Christophe's citadel atop a 4,000-foot elevation with steep slopes. This amazing structure and the journey to reach it leave a lasting impression.

In Haiti I was thinking of some reptiles that would be of high interest in the Zoological Park. There is the big rhinoceros iguana, with a horn on its snout. It is the heaviest member of the iguana group. And there is a six-foot grayish snake that rears high from the ground with

spread hood like a cobra. But it is harmless; in fact, there are no poisonous snakes in Haiti. Why it should act like a cobra, when there are no cobras in the New World, is interesting as a phase of reptile psychology. Some harmless snakes simulate the actions of dangerous kinds also living in their territory, but here there is no possibility of inducement by imitation. It seems that the Haitian snake, for which several natives told me they had great respect, is a wholly unrelated example of parallelism; its elongated, dilatable neck ribs and actions in assuming fearsome poses are nothing more than that. At any rate, it is a lure to find out more about it and next year's holiday is already shaping in my mind for a stay in Haiti.

No specimens were brought back except a cage with three young grisons for Childs Frick of the American Museum of Natural History. They came from the March collection and I was told that several attempts had been made to transport the young of these animals, but that they had died. It seemed natural to have something alive to look after and to figure on special diet, which included a crate of pigeons from Port-au-Prince. There was a bit of shifting of the cage to give the animals fresh air yet protect them from the tropic sun on deck; and again to shelter them from sudden cold, into which the vessel ran in converging with the northern shore, but they were safely landed in New York and Mr. Frick tells me that they are feeding well. And that, of course, is how every trip with animals ought to end!



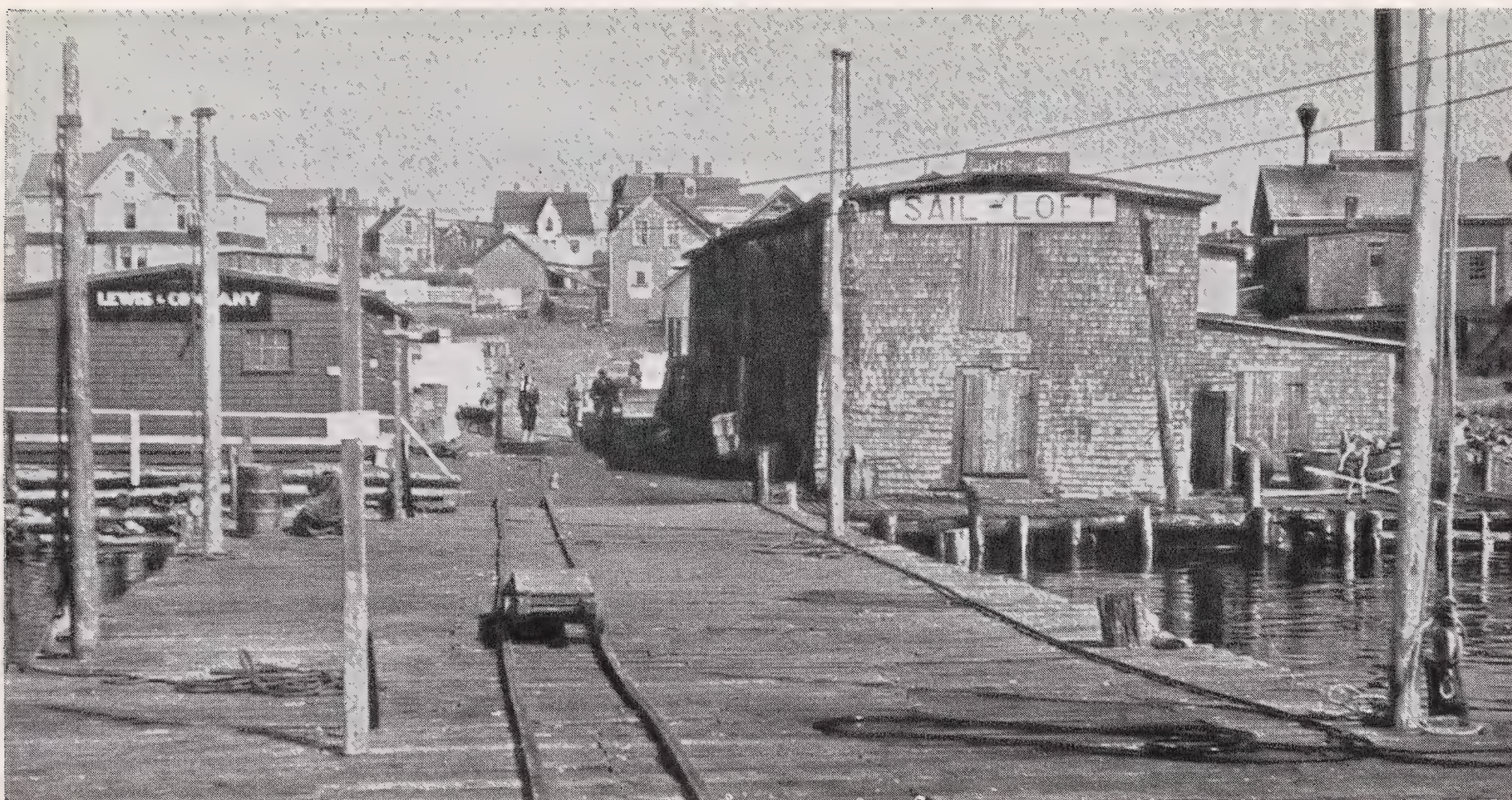


Photo by H. C. Raven

In the old sail loft beside the Louisburg dock, where the fishing fleet unloaded and weighed its catch, was the expedition's laboratory for research into the life of the swordfish.

In Quest of Broadbill and Marlin

Science Joins with Sport in Expeditions to Cape Breton and Bimini to Study the Natural History of these Fish

FRANCESCA LAMONTE

*Associate Curator of Ichthyology
American Museum of Natural History*

Last year the coast of Cape Breton Island, Nova Scotia, saw the beginning of pursuit by the American Museum of Natural History of those giants of the deep, the broadbill, or swordfish, and the marlin. And another beginning too—expeditions combining science and big game fishing in the study of two closely related fishes in which both are so much interested.

These expeditions were made possible through the generosity and interest of Michael Lerner, Field Associate of the Museum's Department of Ichthyology.

The plan is to follow the two creatures around the world, and to try to map out accurately the life history of those individuals that appear off our coasts—how and where they breed, what they eat, the course of their migrations. The initial phase is, of course, a thorough knowledge of their anatomy and physiology, and this must be studied on their own grounds, for both swordfish and marlin weigh hundreds of pounds, average ten feet in length, and are practically impossible to transport intact to a Museum laboratory, and certainly too costly and difficult to transport in any quantity.

IT was blowing a gale when we got to Louisburg. The gray-shingled, shutterless houses stood bleakly along the deserted street. The spruce and balsam woods farther back where the land rises were desolate with the gray ghosts of fallen trees, eaten by sawflies. Yet Louisburg from the water, as we so often saw it later on, is beautiful. Little islands fleck its deeply indented harbor, and on either side rise tall white lighthouses and the ruins of ancient fortifications.

Down on the docks the men of the swordfish fleet sat around silently. Their lean Scotch faces showed the characteristic marks of their occupation, the upper face white where the long visor of the swordfisherman's cap protects it; the lower burned and weather-beaten. Beyond the coaling wharf lay two Gloucester schooners, one of them the *Cachelot* formerly on the Grenfell Mission run. They looked massive beside the small boats of the local fleet.

Our expedition boats were there too. The

Vigilant with her widespreading outriggers for rod and reel fishing, was under repair, a practically permanent condition and the reason why Mr. Lerner made his three catches from a dory. Beside her lay our collecting boat, one of the regular fleet, the *Kalama*. Her owner explained that three a's in a boat's name are lucky. He got the idea of that name, he said, from a word he ran across in a magazine—Kalamazoo.

Finally, there was the boat lent us by the Dominion Government, the *Margaret S. II*, a reconditioned rum-runner with a strange lurch that reminded me unpleasantly of various Baltic Sea cargo boats.

The energetic Michael Lerner had arrived in advance of the rest of the Museum party—Mr. Nichols, Mr. Raven, Miles Conrad, Ludwig Ferraglio, Anthony Keasbey and I—and had our

laboratory all arranged in the old sail loft and our shipments from New York installed and opened. We were right above the dock, opposite the weighing-in scales, with a second story back door that opened into space above the boats of the fleet.

Louisburg has always been a fishing village. It was settled by fishermen from St. Pierre and Newfoundland, and as a fishing village it survived not only efforts by the French to establish there an impregnable fortress in the New World, but capture of this enormous fortification by the British, reoccupation by the French, and, finally, its deliberate demolition by the British, most thoroughly accomplished under the charge of Lord Byron's grandfather.

The Government is at present excavating the remains of its thirty-foot-high masonry wall, its



Photo by H. C. Raven

Louisburg's swordfish fleet has a good day now and then—and this is one of them, when there were "whups" of fish on the dock. Provided the research staff got there before the fish were "dressed," a catch like this furnished an abundance of specimens for measuring and weighing.

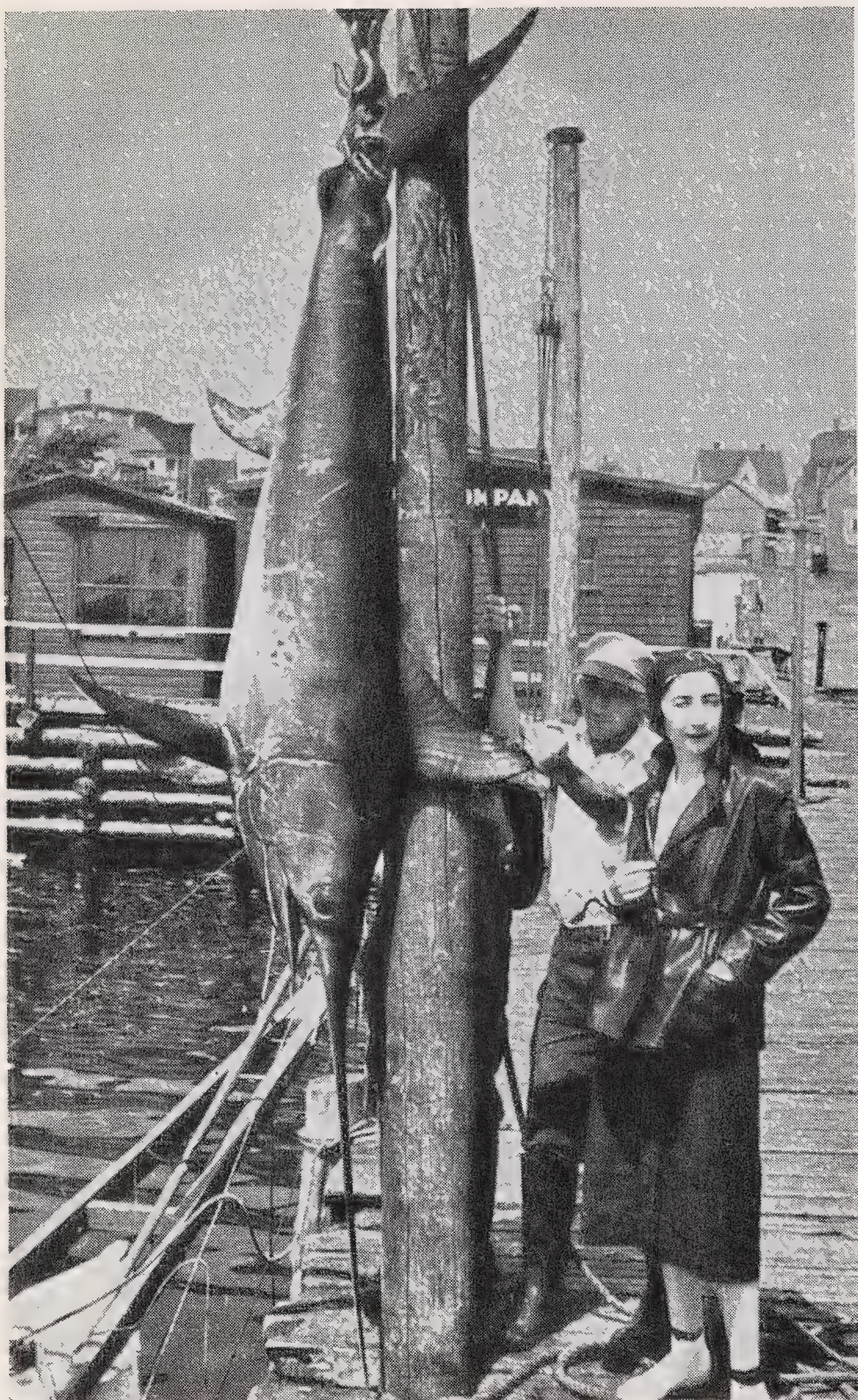


Photo by H. C. Raven

Besides utilizing the catches of the commercial swordfishermen, the expedition depended upon its own boatmen for specimens.

palisade, cannon embrasures, citadel, military hospital, officers' houses and its "grande batterie" and bomb-proof casemates from beneath land that has served since 1760 as a sheep pasture. From the moat, the small new museum has rescued pieces of heavy blue and white china used by the British, and fine crystal, porcelain, and coroneted silver left by the French.

But coroneted silver and bright uniforms have long since departed, leaving Louisburg as it began, a small fishing village dependent for its living on the sea, which gives it a short lobster season from May to July, and, as its chief source of income, the swordfish.

Louisburg people seem to be existing on an inexhaustible reserve of quiet courage. Their occupation is dangerous and does not provide an easy living, but I never heard one of them

complain. The deafening noise, shoutings and confusion of Hollywood portrayals of the business of wresting a living from the ocean are entirely absent at Louisburg. When the man up on the mast of a swordfishing boat spots below him the dark dorsal fin of his week's, or maybe his month's, livelihood, he leans down a bit, saying in a mild voice to the rest of the crew—the man at the engine—"Hey, hey," rather apologetically, as if he regretted having to disturb his friend. The engine tender then crawls forward onto the harpoon pulpit while his companion comes down the mast to help when the fish is struck.

The swordfish does not seem to sense the approach of the boat, but at the very last moment, just as the harpoon with its arrow-shaped dart is descending, the fish often slips smoothly to one side and sounds. If it is struck, the men let it run until it is exhausted, the surface marker, a keg, showing that it is moving more and more slowly. Although this fish is so powerfully built, it seems incapable of prolonged action and displays none of the speed or endurance of the tuna. But it puts up a struggle when it is finally being pulled into the boat; a very dangerous struggle for these small boats and even more dangerous when the landing is made from a dory.

We got fresh from the boats as many specimens as we wanted for our studies, providing we reached the docks before the commercial fishermen had "dressed" the fish. This process is rapid, deft, and, in Louisburg, silent. The purplish-bronze fish is landed on the dock; two men then remove its head, all fins and all viscera; hose it off; put it on a hand truck, and push it to the weighing-in scales. Here its weight is chalked on its side and entered in the agent's book. The fish is then removed to be packed in long wooden shipping boxes. Swordfish livers are weighed separately and shipped in cans. They are sold for their medicinally valuable oil. The livers are large and compact and the smaller the fish, the greater seems to be its proportional liver weight.

"Right around," that is, intact, the swordfish weighs much more than when "dressed." Our three rod and reel catches, two of which are now on exhibit as mount and skeleton in the Hall of Fishes of the World, weighed respec-



Photos by H. C. Raven and Hedley Doty

(Top). The harpoon pulpit from which the Louisburgers make their swordfish strikes is uncertain in the smoothest of seas. (Below). But the hazards are far greater when the waves are high, as they ordinarily are. This is a view of a swelling, tossing, typical Louisburg sea.

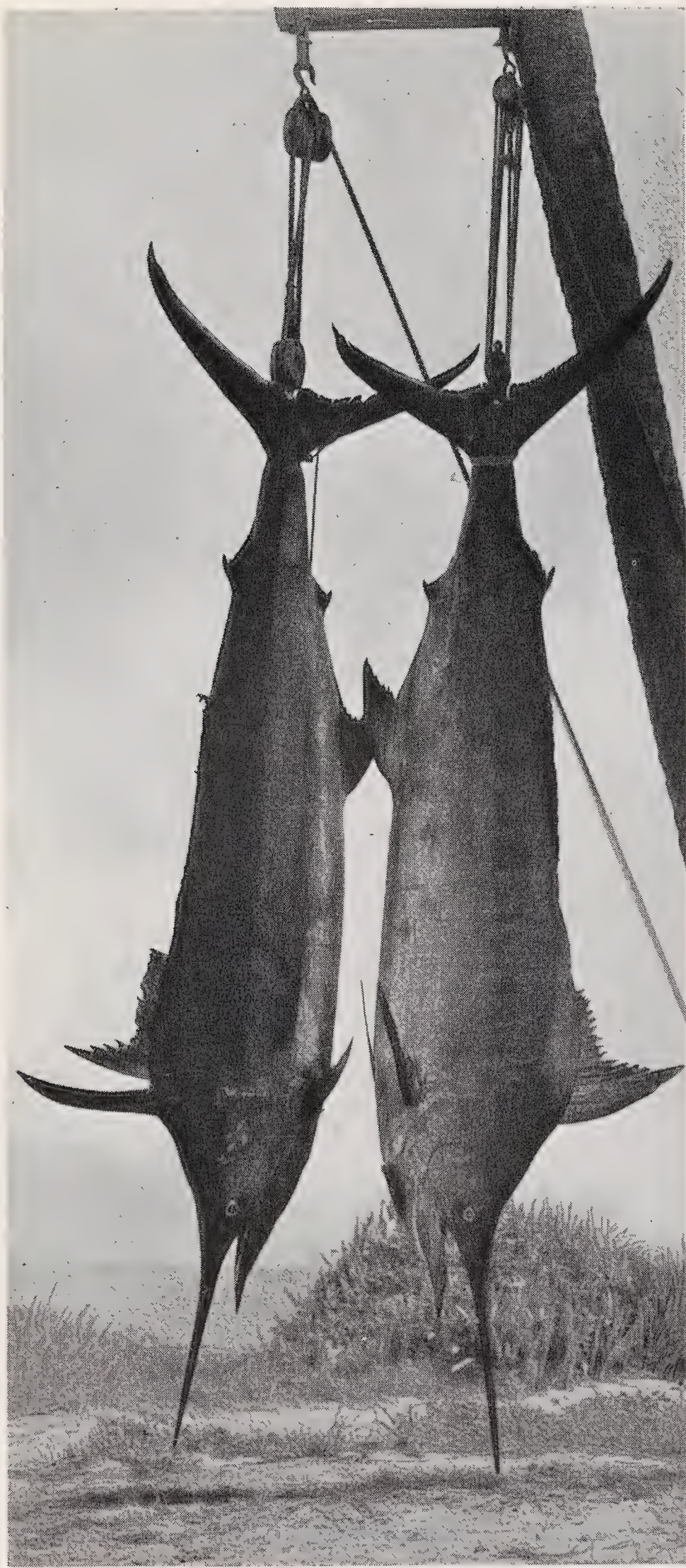


Photo by Hedley Doty

Two magnificent specimens of the marlin taken by the sportsmen who supplied the research staff when it went to work at Bimini.

tively 462, 535, and 601 pounds "right around." The meat of our catches was eaten by the fleet and their families with seeming appreciation, for although swordfish meat is delicious, the fishermen have to sell their catches unmutated.

It is a clean, white-fleshed fish, very easy to work on. Its parasites are confined to non-

edible parts and do not enter the flesh, and its comparative lack of blood and entire lack of scales made it much easier for us to handle than the thick-skinned, full-blooded tuna, or the marlin with its irregularly arranged and thorn-like scales.

This powerful fish is a highly specialized relative of the mackerel, but it has evolved beyond them in its digestive system and in its skeletal characters. One of its most striking characters to the casual observer is its relatively small mouth, with delicate bony framework and no teeth in the jaws. The first feature one notes upon dissection is its very large stomach. From the condition in which we found their stomachs, swordfish obviously come to Louisburg to feed.

The following fall or winter would be the logical time for them to spawn, but where this lot of fish spawn we do not yet know. The behavior of the swordfish is more or less well-known in several separate localities, but the facts have not been correlated and there are so many gaps that we really know very little of the consecutive story of its life. If we knew more, as we eventually hope to, we might have forecast such a disaster as this season was for Louisburg, when the whole catch for three months was about equal to one day's catch in the very short and not over-profitable season of last year. We might have foreseen this, and might have been able to predict where those fish would be running instead. We have a very warm feeling for Louisburg and its people, and would like to hear, for every day of its sword-fishing season, the report that one of the fleet dashed in with last summer, "There's whups of them on the dock!"

Nothing could differ more from Louisburg, than the scene of the Museum's expedition this summer, when three of last year's party—Miles Conrad, Ludwig Ferraglio and I—were again indebted to Mr. Lerner's cooperation and generosity for a month's stay on the marlin grounds off the sun-baked, coral island of Bimini.

No wonder Bimini is the big game fisherman's paradise. The marlin grounds seem inexhaustible and lie close to the harbor and the season is long. But in spite of this supply there is no commercial fishing there at all and we were com-

pletely dependent for our laboratory specimens on the sports fishermen who were only too glad to have their catches utilized.

Bimini has been "discovered" several times. Its original inhabitants were Indians; it was then discovered by the Spanish; then by the British who brought to the Bahamas as their slaves the forefathers of the present natives. There are only four or five white residents on the island.

On calm days it might seem a beautiful spot to live, but unfortunately it lies very low and directly in the path of hurricanes, which have left their traces in the partial ruin both of vegetation and of buildings. But despite its natural disadvantages, in recent years this small place has undergone its final and most profitable discovery—by game fishermen.

The blue marlin is an incredible fish when you first see it alive. The soft blue of its stripes and on its fins is unbelievably intense. This color fades almost before the fish is landed, and becomes a uniform rubbery black. Its flesh, although edible, is not very appetizing when fresh. But the fish is caught in such quantities off Bimini and Cat Cay that the sportsmen themselves have raised the question of what is to be done about it.

From our examination, it is not very likely that any organ of the blue marlin is worth commercial consideration, as is the liver of the swordfish. But the smoked flesh of the blue marlin is one of the most delicate of foods, and there seems to be no vital reason why a smoke-house should not be both a source of utilizing these catches, and of income and employment



Photo by Hedley Doty

Within a few minutes after marlin were landed on the pier at Bimini, the investigators were at work with measuring tapes. The rough, preliminary examination could be made here before the fish was cut up for a more detailed study of its skeleton and internal organs.

for the natives of Bimini, most of whom at present appear to earn a very meagre living.

This summer the Lerner-Bimini Expedition used the catches. We had two laboratories on the island, one in Mr. Lerner's guest house, and the other in a tent where we did most of our work on the marlin. One has to work rapidly in such a climate, for specimens go bad quickly and there is almost no ice on the island. As soon as the fish came in we began our work, first careful cutting for what we wanted of the internal organs, or for our anatomical photographs which were easy to take in that splendid bright light; then rougher work for the skeletal parts that we wanted to ship back to be thoroughly cleaned and de-greased in the Museum vats (a process of many weeks duration); then examination of the smaller parts in the guest house laboratory where we kept our microscope and instruments, and then the final packing in

suitable preservative to be shipped back to New York.

Off Louisburg there were almost no smaller fishes except the common herring, cunner and stickleback. But in Bimini we also worked on some of the more valuable of the numerous tropical species, collecting them with rod and reel from our boats, with handlines from the skiffs or the docks, with traps, nets, or by diving for conch shells where some of them live. Lots of rare little fishes are also to be found in the golden weed of the Gulf Stream. We watched the reef fishes at their daily life through diving helmet and glass-bottomed boat and only wished we could observe the marlin in the same easy way. But the marlin, too, will have to yield eventually to our inquisitiveness about its habits, for we intend to follow it and its relative, the swordfish, round the world until our ichthyological curiosity is satisfied.



Photo by Hedley Doty

In the tent laboratory close to the pier, most of the detailed examination was carried on and parts wanted for further study were removed and preserved for shipment to New York where data is accumulating that will eventually reveal the life story of the marlin.

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NOTES FROM THE ZOOLOGICAL PARK AND THE AQUARIUM

Dr. Townsend Retires

Dr. Charles Haskins Townsend retired on November 1, at the end of just thirty-five years as Director of the New York Aquarium.

His relinquishment of the exacting duties of maintaining a great collection of aquatic animal life does not, however, mean a cessation of activity. He expects to continue his supervision of colonies of Galápagos tortoises established in this country and elsewhere, and will engage in other research problems. A series of articles and pap-

ers, for the *Bulletin* and *Zoologica*, are promised from his pen.

An account of Dr. Townsend's work for the U. S. Bureau of Fisheries and his part in developing the Aquarium after it was placed under the auspices of the Zoological Society will be published in a subsequent *Bulletin*.

Charles M. Breder, Jr., who came to the Aquarium in 1921 as Aquarist after service as a fisheries expert for the Bureau of Fisheries, and who has been Assistant Director for several years, took up the acting directorship on November 2.

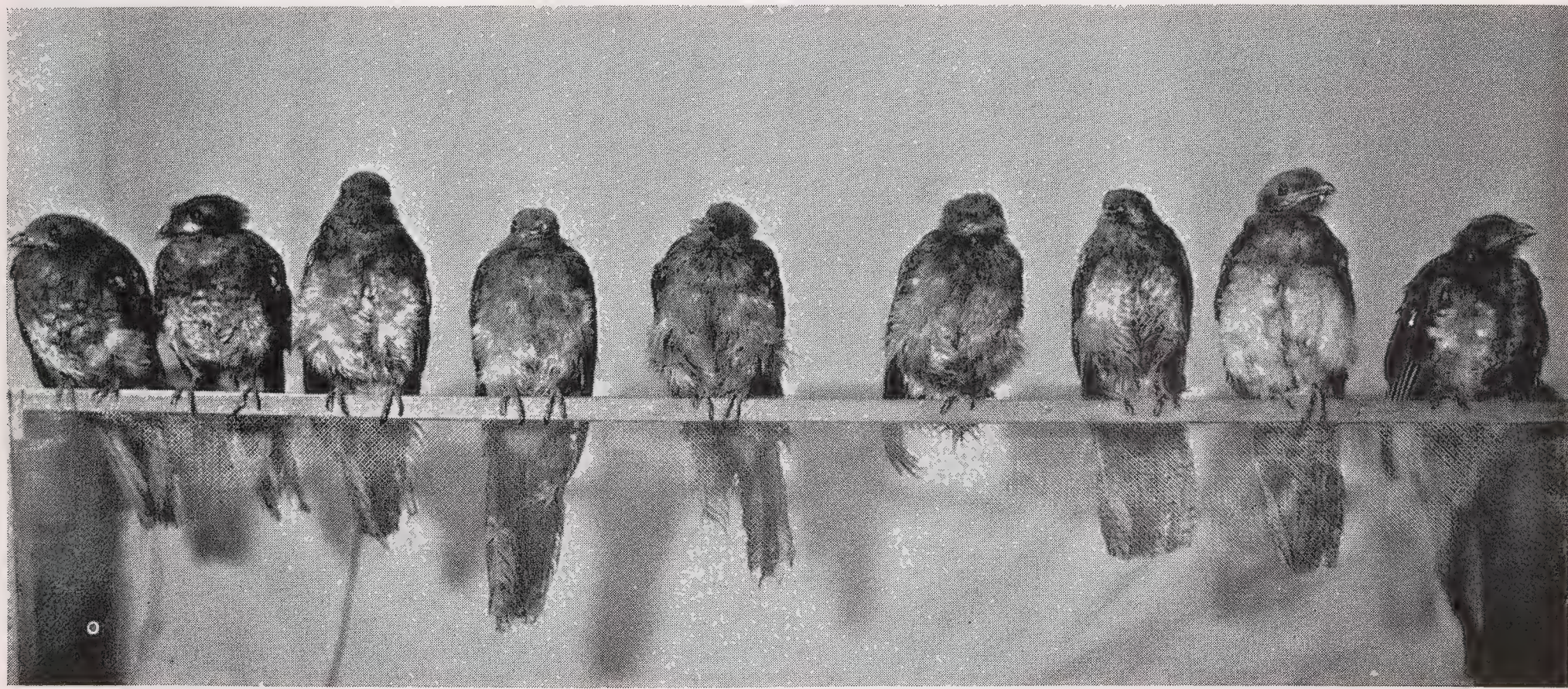
The First Quetzals

Three South American quetzals were added to the Zoological Park's bird collection on October 28. It is the first time they have been seen in captivity since the Spanish conquest of the Aztecs four hundred years ago.

Adult male quetzals are the most beautiful birds in the New World and in some respects exceed even the birds of paradise. The body of an adult is about the size of a crow, but the feathers of the back and the wing coverts are green-gold and the breast is scarlet. The chief feature of the male's beauty are middle upper tail coverts more than two feet long, of a golden green iridescence that appears bright blue in certain lights.

The birds were strictly protected by the Aztecs and only their rulers were allowed to wear the long tail plumes plucked from the birds they kept in captivity. Explorers in northern South America have rarely seen quetzals, although museum collectors have obtained a few specimens, and at one time they were occasionally killed by plume hunters.

No living birds were obtained, however, until last summer when Dr. V. W. von Hagen and his wife went to Honduras on an ethnological expedition. They discovered nests and captured a number of very young birds. Most of the summer was spent in establishing them on a simple fruit



The nine young quetzals showed evidence of their rearing by hand when they were lined up to be photographed. They were so tame that they sat quietly and only one or two attempted short flights around the room. Their caudal plumes are not in evidence yet.



The two stone figures of Señor Lopez have been set up at the entrance to the Italian Garden and so flanked with evergreens that they have a most natural setting. The massive muscular development of the animal is splendidly illustrated in these photographs.

diet and late in October nine specimens were old enough to travel.

They arrived in New York on October 28 in perfect condition, except one bird whose wing had been broken. Two of the birds in good condition—a male and a female, it is hoped—were purchased for the Zoological Park's collection, and the bird with the broken wing was retained for treatment. The six remaining birds left in mid-November for the Zoological Society of London, in care of a representative of that Society.

The birds are still in their juvenile plumage and are at present quite undistinguished in appearance, except for an occasional feather that reveals the beauty to which they will later attain. It may be a year or more before they arrive at their magnificent adult plumage.

Difficulty with their diet was anticipated, since they had to be fed by hand on a rather special diet when they arrived. They have been established on a varied ration that includes alligator pears, bananas, rice, soft-food mixture, eggs, cheese, ant eggs, mealworms, grapes, pears and codliver oil. On November 11, for the first time, two of the three birds rejected hand-offered food and began feeding for themselves.

The Latin name of the quetzal is *Pharomacrus moccino*. The photograph accompanying this note is perhaps the first of a living quetzal that has ever been published except in newspapers when the present birds arrived.

Señor Lopez in Stone

The first large member of the cat family in the collections of the Zoological Park was a magnificent jaguar named Señor Lopez. He came in 1902, the gift of William Mill Butler, a Life Member of the Society who at that time was Acting Consul-General for Paraguay at Philadelphia.

The great size, graceful proportions, and—on one occasion, at least—the ferocity of Señor Lopez are almost legendary among the staff of the Zoological Park even today. It was, therefore, with pleasure and eagerness that Dr. Blair this fall accepted the offer of Mr. and Mrs. Archer M. Huntington to present to the Park two pieces of sculpture by Mrs. Huntington, representing Señor Lopez in familiar, life-like poses.

The stone figures were executed by Mrs. Huntington in 1935 from models she made in the heyday of Señor Lopez, when he was a fully adult, active and vigorous animal. They were set in banks of low-growing evergreens on either side of the entrance to the Italian Garden, not far from the two buildings where Señor Lopez was housed during his long life in the Park.

The jaguar was presented to the Park before the Lion House was built, and temporary quarters were found for him in the large cage at the north end of the Primate House. The installation of a great carnivore among animals on whose

relatives he may sometimes have preyed caused the utmost confusion and disturbance. For the whole of the first day that Señor Lopez was in the Primate House, excited monkeys screamed and yelled at him. Every monkey within sight of his cage gathered at the front of their own cages and reviled the newcomer. Señor Lopez disdained their outcries.

Some years later, after the jaguar had been given comfortable quarters in the Lion House, an effort was made to find him a mate. A handsome female jaguar was installed in an adjacent compartment, with a heavy netting through which the two animals might become acquainted. After several weeks of seemingly pleasant relationship, the screen was removed and the way opened for them to occupy the same cage. Señor Lopez bounded through the opening, seized the female by the neck, and with one snap of his jaws killed her.

The eleventh of the series of murals which Mrs. Charlotte Chase of Scarsdale has been painting for the Aquarium in the past two years was installed under the rotunda of the Aquarium early in November. The scene, in the style of the other murals showing underwater life, represents the habitat of the spiny lobster and the giant starfish. Space is available for four more murals.

Two Lion Cubs

The two lion cubs born at the Zoological Park on July 11 are developing into magnificently healthy young lions. Much of the time they spend

in the Studio at the north end of the Lion House, off of exhibition, but their mother has gotten over the nervousness she displayed when the cubs were born and is less inclined to shield and hide them when they are in the exhibition cage.

Robert Gibbings, the author of the article, "An Artist on the Sea Floor," is an English artist whose work as a book illustrator is known on both sides of the Atlantic. He operated the Golden Cockerel Press for some years and is now on the staff of Reading University.

Legionnaires at the Aquarium

The popularity of the Aquarium with visitors to New York has seldom been better demonstrated than during the convention of the American Legion in September. The following attendance figures tell the story of the five days that the convention was in progress.

ATTENDANCE			
	Last Year	This Year	Increase
Monday	5,863	11,331	5,468
Tuesday	6,308	8,890	2,482
Wednesday	4,026	12,030	8,004
Thursday	3,856	6,144	2,288
Friday	4,345	4,866	421
Total	24,398	43,251	18,863

During the convention the Aquarium's attendance increased 41 per cent. over the corresponding days of the previous year.

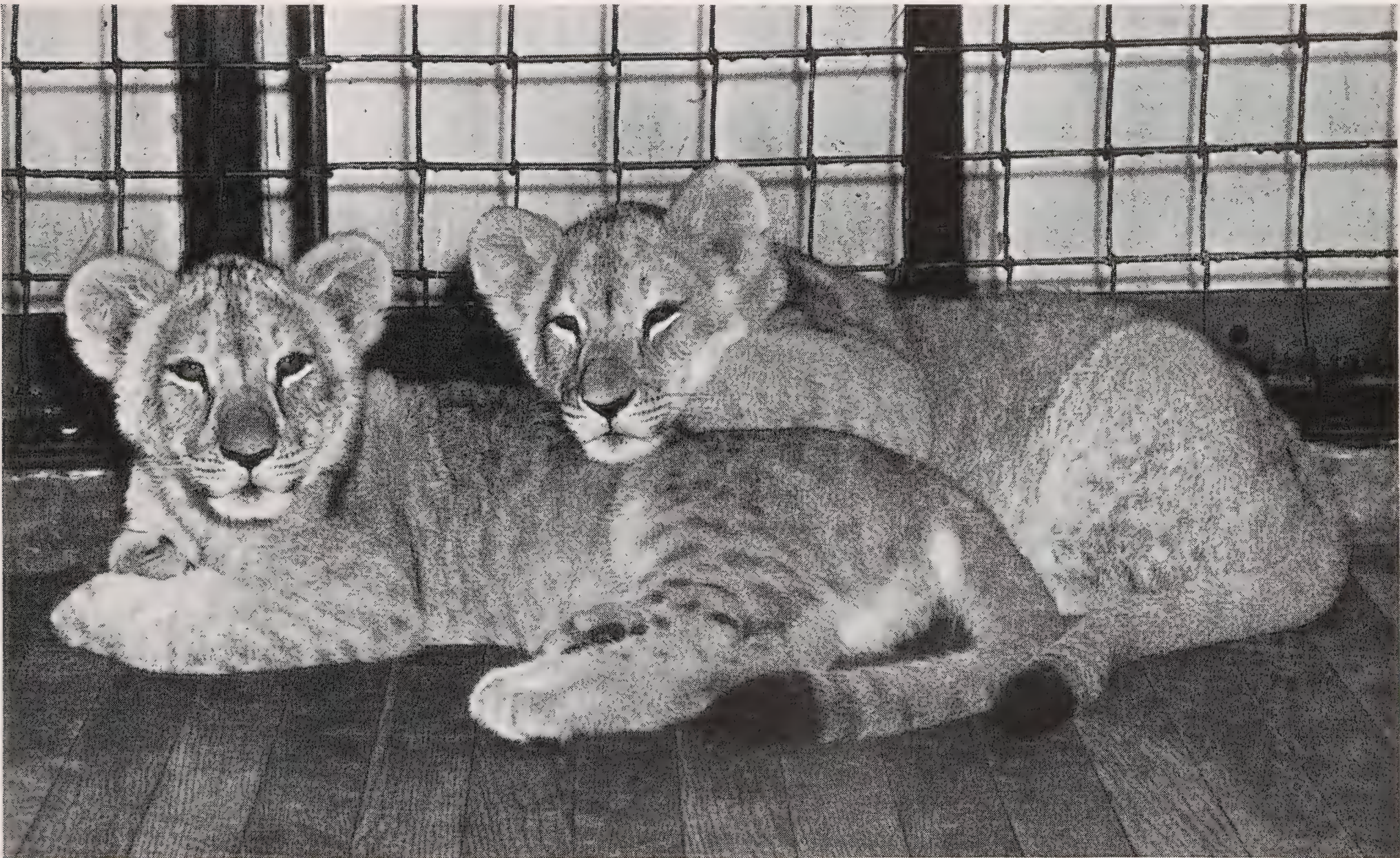


Photo by Joe Lyons, The Sun

A pair of lion cubs healthier and stouter than these youngsters born in the Zoological Park's Lion House last July 11 has seldom been seen. Careful attention to their diet—with plenty of bone meal and codliver oil—as well as seclusion in their early days, are responsible.



Photo by Joe Lyons, The Sun

A baboon and a white rabbit are an odd combination to find in a Zoological Park, but these two are devoted and apparently quite contented friends.

Damon and Pythias

The arrival this fall of a young olive baboon for which there was no room in the Primate House created an unexpected problem that has been solved with great success.

Temporarily, until exhibition room is available, the young baboon was quartered in a spare cage in the Hospital. But baboons are gregarious animals, and like to have the company of their own kind. The newcomer, in addition, was a baby, hardly more than a year old, and it wanted a companion in play.

For most of the first few days in the comparative isolation of the Hospital the youngster made the place noisy with its lonesome cries. It was obvious that all it needed was companionship, and since no other healthy monkeys were on hand to share the cage, Dr. Schroeder thought of a substitute. He sent to the Nursery for a large

and placid white rabbit and introduced it in the baboon's cage.

The rabbit proved to be the ideal playmate and companion. It hopped around for a few minutes, its nose twitching, and then settled down to a luncheon of lettuce without paying the slightest attention to the baboon. The young baboon, on the other hand, ceased its crying, explored the rabbit minutely, and adopted it as a pleasant, if not exciting, friend. It ran alongside when the rabbit hopped about the cage, threw its arms about the rabbit's neck and went to sleep when the rabbit settled down to eat, attempted to ride on the rabbit's back (without much success), and a few times was observed "picking fleas" from its back.

The two animals are the most peaceful inhabitants of the Hospital at present. They never quarrel, and the rabbit, although not as demonstrative as the baboon, gives every evidence of contentment.

PUBLICATIONS OF INTEREST

ANIMALS FOR SHOW AND PLEASURE IN ANCIENT ROME. By George Jennison, M.A., F.Z.S. Manchester University Press, 1937.

Here is a small volume of a scant two hundred pages representing an enormous amount of research through the scanning of centuries-old accounts written in the original Latin and Greek. Hundreds of marginal references found throughout the book attest to the industry of the author. Their imposing array should not frighten away the prospective reader, however, for the result is a pleasing and informative volume, especially to those of us whose interest in animals furnishes a life work.

Few of us today realize what an important part wild animals played in the every-day life of the ancient Greeks and Romans, especially during the period immediately preceding and following the beginning of the Christian era. Here we are reminded of the great animal industry which flourished under the Caesars. The author notes the tremendous strain placed upon the primitive transportation facilities of the day, the appalling loss of animals in transit and the enormous number of persons engaged in the industry, mainly to the end that the demands of the arena could be satisfied. In one instance, when Trajan celebrated his conquests of Dacia, 11,000 beasts were killed in the Colosseum at Rome.

Egypt, under the Ptolemies, did not use wild beasts to such an extent as the Romans to satisfy their lust for blood, but instead specialized in processions and spectacles. Press agents of the day must have been pretty good, for the record survives of a forty-five-foot snake captured for one of these shows during the reign of Ptolemy II (283-246 B.C.). This period was also responsible for a procession which took all day to pass through the stadium at Alexandria and included, among other animals, ninety-six elephants, fourteen beisas, thirty hartebeests and twenty-four saiga antelopes, all in harness!

The chapters on capture and transport, amphitheatres and the arena, are of special interest to persons concerned with the present-day exhibition of wild animals.—C. W. L.

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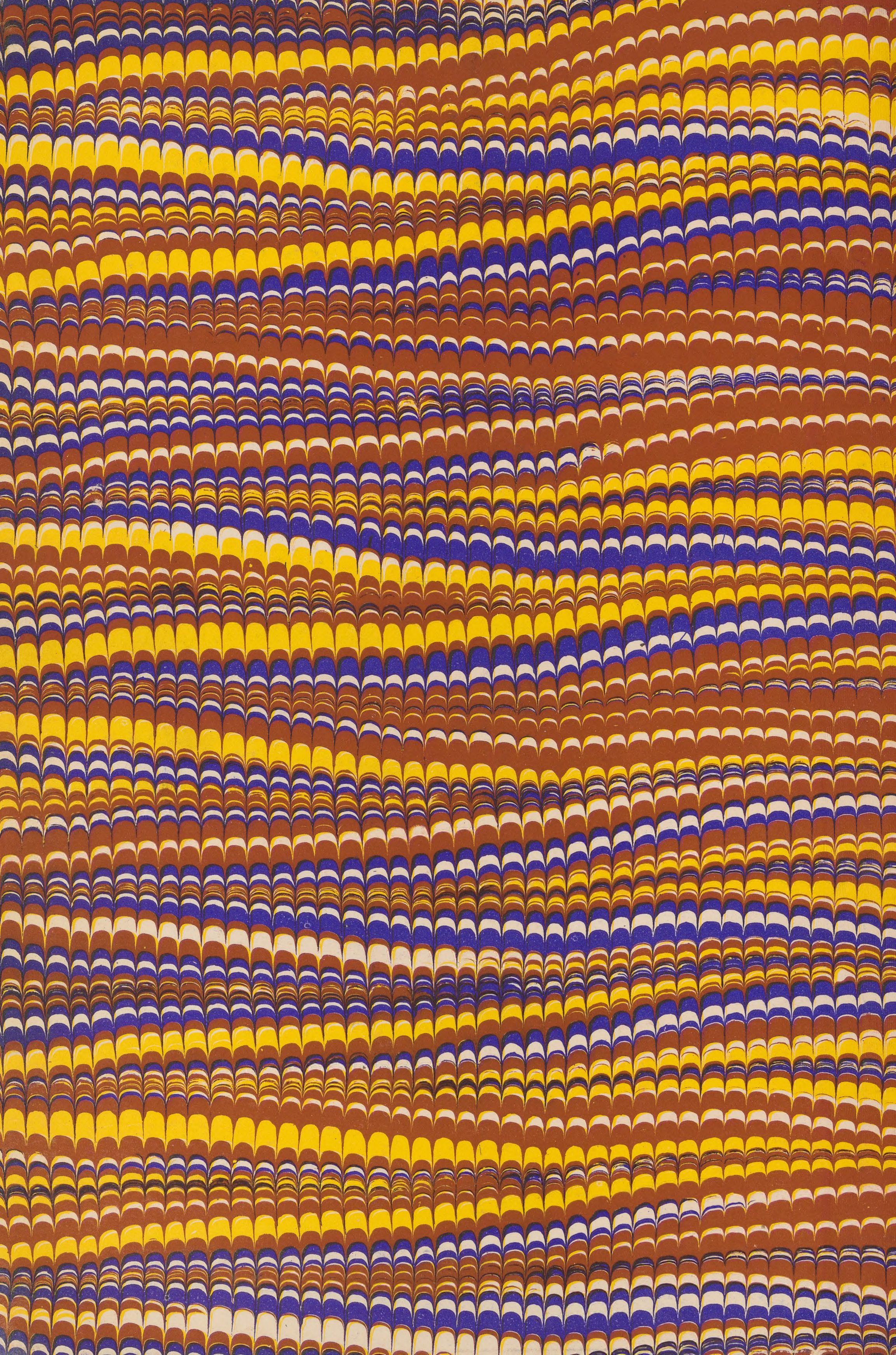
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